Field Study of WIND EROSION in Western Texas

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FIELD STUDY OF WIND EROSION IN WESTERN TEXAS [1]

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Introduction

A field investigation designed to gain specific information on the various factors causing erosion of cultivated lands in Hale, Lubbock, Terry, and Lynn Counties in western Texas was carried out in November 1952, March 1953, December 1953, and January 1954.

This area had experienced four consecutive seasons of below-average precipitation at the time the study was completed. A fair yield of sorghum and cotton was harvested on dryland in 1952; and virtually no yield was obtained in 1953. Conditions were especially severe in Terry and Lynn Counties The weather throughout the winter, spring, and summer of 1953 was unusually dry and much wind erosion occurred, especially on sandy lands. Substantial rains fell in the fall of 1953 but were too late to produce ground cover sufficient to protect the soil, some of which was virtually bare, against wind. The first severe wind erosion following the rains occurred in Terry and Lynn Counties on December 11, 1953. This was followed by several more windstorms before this study was completed January 28, 1954.

Soil Conservation Service personnel serving the area, the Texas Agricultural Experiment Station, and the Texas Technological College participated in the investigation. The study comprised (a) analysis of climatic data, (b) erodibility tests using a portable wind tunnel brought from the wind-erosion laboratory at Manhattan, Kans., and (c) analysis of soil characteristics related to erodibility by wind. Field headquarters for the work were established at the Texas Technological College at Lubbock and the Terry County Experiment Station at Brownfield, Tex. Analytical work and the assemblage of experimental data were performed at the research headquarters at Manhattan. This report summarizes the results of investigation.

General Description of Area

The lands of Hale, Lubbock, Terry, and Lynn Counties are a part of the High Plains and lie at an altitude of 3,000 to 3,500 feet above sea level. The average annual precipitation is about 18 to 20 inches.

The soils belong to the reddish-brown and reddish-chestnut soil zones and comprise the Amarillo, Pullman, Mansker, Drake, Zita, and Springer series. Both high- and low-lime soils are represented. The texture of the soils becomes increasingly coarse from north to south Clay loams predominate in Hale County, sandy loams and loamy sands in Terry County. The native vegetation was short grass with a scattering of mesquite and catclaw brush, the latter occurring largely in the sandy soils.

Cotton, sorghum, and wheat are the main crops on the dryland area. The dominant crop on the heavier soils of Hale County is wheat. In Lubbock, Terry, and Lynn Counties the major crops are sorghum and cotton.

Procedure

Analysis of Climatic Data

Wind and precipitation data from Substation 8 of the Texas Agricultural Experiment Station, 4

[1] Contribution 503, Department of Agronomy, Kansas Agricultural Experiment Station, Miscellaneous Publication 110, Texas Agricultural Experiment Station; Soil Conservation Service; and Agricultural Research Service, Soil and Water Conservation Research Branch, Cooperative research in the mechanics of wind erosion, Manhattan, Kans.

[2] J. R. Coover and J. C. Ebersole of the Soil Conservation Service participated actively in the field study. Acknowledgment is made to V. W. Woodman, H. A. Taff, C. J. Whitfield, and A. W. Young for assistance in organizing this study.

miles east of Lubbock, were analyzed. An anemometer was 4 feet above the ground. While data cover the period from 1911, only those from 1930 to 1954 were included in the study of climatic records. The seasonal patterns of precipitation and wind, intensity-frequency of wind movement, and combination of rainfall and wind movement were studied.

Selection of Sites

Thirty fields were chosen for portable wind-tunnel tests. An attempt was made to select one site representing average conditions of each field. These sites and 10 others were used for analysis of certain soil characteristics related to erodibility by wind. A range of soil texture, land capability, and cropping and tillage practices was included. Site numbers were assigned, on the basis of lowest to highest erodibility, to fields on which portable wind-tunnel tests were made. Site numbers were also assigned to other fields in the order they are discussed in this report.

The soils used in this study are described as follows:

Capability unit	Mapping unit and soil type	Description
II-2	2-A-1R Pullman silty clay loam	Deep, fine-textured, slowly permeable soils, slope less than 1 percent, less than 25 percent of topsoil removed by wind.
II-2X	2X-A-1R Zita sandy clay loam	Deep, fine-textured, moderately permeable soils, 0-1-percent slope, less than 25 percent of topsoil removed by wind.
II-7	7-A-1R Zita and Amarillo fine sandy loam	Deep, medium-textured, moderately permeable soils, slope less than 1 percent, less than 25 percent of topsoil removed by wind.
II-7	7-A-2R Amarillo fine sandy loam	Same as above except 25-50 percent of topsoil removed, predominately by wind.
II-7X	7X-A-1R Mansker fine sandy loam	Deep, medium-textured, rapidly permeable soils, 0-1-percent slope, less than 25 percent of topsoil removed by wind.
III-$7X_f$	$7X_f$-A-2R Drake fine sandy loam	Similar to 7X-A-1R except that the soil is extremely calcareous, and 25-50 percent of the surface soil has been removed, primarily by wind.
III-70	70-A-1L Amarillo fine sandy loam	Deep, coarser than normal medium-textured, moderately permeable soils, 0-1-percent slope, with soil accumulations less than 6 inches thick.
III-70	70-A-2R Amarillo fine sandy loam	Same as above except 25-50 percent of surface soil removed, primarily by wind.
IV-L12	L12-A-2R Amarillo loamy fine sand	Deep, coarse-textured, moderately permeable soils, surface soil less than normal thickness (approximately 14 inches), 0-1-percent slope, 25-50 percent of surface soil removed, primarily by wind.
IV-L12	L12-B-2L Amarillo loamy fine sand	Same as above except on 1-3-percent slope and with soil accumulations more than 6 inches thick.
VI-12X	12X-A-2R Springer fine sand	Deep, coarse-textured, moderately rapidly permeable soils, 0-1-percent slope, 25-50 percent of surface soil removed by wind.

Portable Wind-Tunnel Tests

Single wind-tunnel tests were made on each site, with the wind applied in each test at right angles to the direction of crop or stubble rows. Wind velocity through the center of the duct was about 38 miles per hour. On slightly and moderately erodible fields, the wind was applied until all of the erodible soil fractions were removed. A time period of 15 to 30 minutes usually was required for the surface of those soils to stabilize. The time required for movement to cease would have been much longer on more erodible fields. Here, the weight of soil removed at the end of successive time periods was determined, and the total amount of erodible soil was then estimated from extrapolation of the trend line of soil loss with time.

When the wind velocity in the center of the tunnel duct is held constant, the wind force applied to the test surfaces varies with the roughness. Soil loss before a surface becomes stabilized in the tunnel duct varies with surface drag to the 2.5 power (8)[3]. This power function of soil loss with surface drag was used to adjust all losses to a common wind-force level of 3,000 pounds per acre. Past experience (11) has shown that this drag is associated with an atmospheric wind expected to occur at 1- to 2-year frequency-intervals in the High Plains.

An aerodynamic roughness of test surfaces, expressed in terms of "ridge roughness equivalent," was determined from pressure relationships measured in the tunnel duct (12). The "ridge roughness equivalent" is an equivalent roughness based on the height of ridges composed of fine gravel 2 to 6.4 mm. in diameter and having a height-spacing ratio of 1:4. For example, if the ridge roughness equivalent is 4 inches, the surface has a roughness and resists wind movement to the same degree as the gravel ridges 4 inches high and 16 inches apart. The ridge roughness equivalent depends on many factors such as height, length, density, and quality of vegetative cover and the size and shape of clods, ripples, and ridges.

Semiportable Wind-Tunnel Tests

In addition to its use on field sites, the portable wind tunnel was located on the Texas Technological College grounds at Lubbock. A nonerodible surface of crushed rock was spread on the ground surface to form a floor for the tunnel duct. Open-end trays 5 feet long, 8 inches wide, and 2 inches deep were placed level with the nonerodible floor at the leeward end of the 30-foot duct. Samples of soil were placed in the trays in the manner normally followed in the stationary tunnel at the Manhattan headquarters (4). The surfaces of the trays were leveled as uniformly as possible and exposed to a 25-mile-per-hour wind velocity at a 6-inch height above the soil in the tray until the movement of soil ceased. The drag velocity of the wind on the soil in the tray was estimated to be 61 cm. per second. This is equivalent to a surface drag of 406 pounds per acre.

[3]Numbers in parentheses refer to Literature Cited.

Soil and Residue Sampling and Analysis

Amounts of crop residue on each field were determined by picking up or raking the material on the surfaces of 3 areas of 1 square meter, picked at random. The material was washed on a 1.68 mm. screen, dried before weighing, and the weights expressed in pounds per acre.

Composite soil samples of about 20 pounds or more from various depths taken only when the soils were reasonably dry, were obtained from selected sites in the 32 fields. They were transported to the field headquarters in shallow trays and thoroughly air-dried. A portion of each sample taken in the fall of 1952 was tested for erodibility in the semiportable wind-tunnel installation. Portions of all samples were dry sieved to determine the dry-aggregate distribution, and the remaining portions were transported to the wind-erosion laboratory at Manhattan for other determinations.

The size distribution of dry aggregates or clods was determined with an automatic rotary sieve used regularly in this work (3), and in a limited number of cases with a hand-rotary sieve designed for use in the field.[4] The number of turns and the speed of turning of the rotary-hand sieve have been adjusted to make the results comparable to those with the automatic sieve.

Mechanical stability, that is, the relative resistance of clods to breakdown by mechanical forces such as sand abrasion or cultivation, was determined by repeated dry sieving (3). The mechanical stability is a relative measure of coherence or strength of cementation of aggregates in a dry state and, as used in this work, is equal to 100 W_1/W, where W is the weight of aggregates greater than 0.84 mm. after the first sieving and W_1 is the weight of these aggregates after the second sieving.

Mechanical composition, or the proportionate amounts of sand, silt, and clay, was determined for all samples by the latest method of Bouyoucos (1). The textural class for each site is based on these determinations. The soil unit designations are made in accordance with "Procedure for Making Farm Planning Soil Conservation Surveys, Region IV," May 2, 1951.

[4]Chepil, W. S., and N. P. Woodruff. Estimations of wind erodibility of farm fields. 1953 Annual Report of Investigations on the Mechanics of Wind Erosion, Appendix K. Manhattan, Kans. Mimeo.

The size distribution of water-stable particles was determined by the modified method of Yoder.

Calcium carbonate determinations were made by treating 5 grams of soil with 0.5 N sulphuric acid solution until evolution of carbon dioxide ceased and then titrating the soil suspension with 0.5 N sodium hydroxide, using phenolphthalein as an indicator.

Results

Climatic Factors

Precipitation and wind movement.--Figure 1 shows the average pattern of wind and rainfall distribution for the period 1930-52. The high winds of March and April tend to occur before the period of substantial precipitation, which begins in May. March and April appear to be the critical months for wind erosion.

The records show greater wind velocity in June than in May. This is the first group of records noted that shows this phenomenon in the Plains area. The location of the anemometer is, however, within the influence of tree windbreaks and buildings. Thus, protection from winds varies with wind direction, and the data may reflect this influence.

Rainfall, wind velocity, and erosion index.--Wind velocities for March and April were at a higher level during 1930-40 than during the subsequent decade (fig. 2). While this condition appears to be common to the Plains area, it is possible that environmental changes in the vicinity of the gage are responsible for part of the apparent change. The wind velocities from 1952 to 1954 exceed those recorded in the previous 7-year period.

The annual amounts of precipitation received in 1930-53 were quite variable (fig. 2). While the average for the 24 years is 17.7 inches, this amount has been exceeded only 9 out of the 24 years. During the 3-year period 1951-53, the precipitation averaged only 13.1 inches.

Precipitation and the level of wind movement have much to do with the wind-erosion hazard and combinations of low precipitation and high winds tend to increase its severity. An erosion index based on climatic factors may be formed somewhat arbitrarily as follows:

It is assumed that E varies as $\dfrac{u^3}{P_1 + \dfrac{P_2}{2}}$, where u is the average.

March and April wind velocity in miles per hour for a given year, P_1 is the precipitation occurring in the previous calendar year, and P_2 is the precipitation occurring in the year prior to the period of P_1. Thus, the index for 1952 would be calculated from

$$u = 6.5 \text{ miles per hour in 1952}$$
$$P_1 = 13.73 \text{ inches in 1951}$$
$$P_2 = 10.91 \text{ inches in 1950}$$

or

$$E = \frac{(6.5)^3}{13.73 + \frac{10.91}{2}} = 14.3$$

Plottings of this assumed climatic index of erodibility (fig. 2) show that the maximum climatic hazard for the period occurred in 1935. The index was at an extremely low level during 1942-51, and a moderate to substantial rise occurred during 1952-54. Validity of the index depends upon the real values of wind movement for a given condition. Here, it may be affected as mentioned previously by environmental changes near the anemometer.

Intensity-frequency of wind movement.--Previous studies have shown that wind-movement data at a given location may be fitted into probability series and its recurrence interval estimated (10). Data for April at the Lubbock substation are arrayed into probability curves (fig. 3) which indicate the following maximum wind velocities for 5- and 50-year recurrence intervals:

Duration period	Recurrence interval 5 years	Recurrence interval 50 years
Days	M.p.h.	M.p.h.
1	15.0	20.0
3	12.0	17.0
7	9.5	13.0
30 (average for month)	7.0	10.0

The average April wind velocity for the 23-year period has been 6.44 miles per hour. From other studies, it has been found that the maximum movement expected to occur for a 3-hour period about once in 10 years is about 4 times the monthly average. This would be 25 miles per hour for this particular gage location. Gusts in such a wind would reach levels of about 3 times the average for the 3-hour period, or nearly 75 miles per hour.

Wind-Tunnel Tests

Photographs of conditions of each of the 30 fields on which wind-tunnel tests were conducted are shown on pages 31 to 60. The fields are arranged in order of lowest to highest erodibility. A summary of the information relative to location, cropping, soil characteristics, amount of crop residue, roughness of the surface, and amount of soil eroded in the portable tunnel is given for each field (table 1, p. 26). The values of mechanical analysis and the percentage of erodible soil fractions less than 0.84 mm. in diameter are from the surface inch of soil.

Marked influence of the factors of soil structure, amounts of residue, and surface roughness on erodibility is apparent from these data. The soil losses range from 0.003 to 410 tons per acre. Certain other factors, such as surface crusting, are not assessable by present methods and complicate the problem somewhat. The three above factors appear to be the major ones, however, and will be considered separately before an attempt is made to derive an overall relationship.

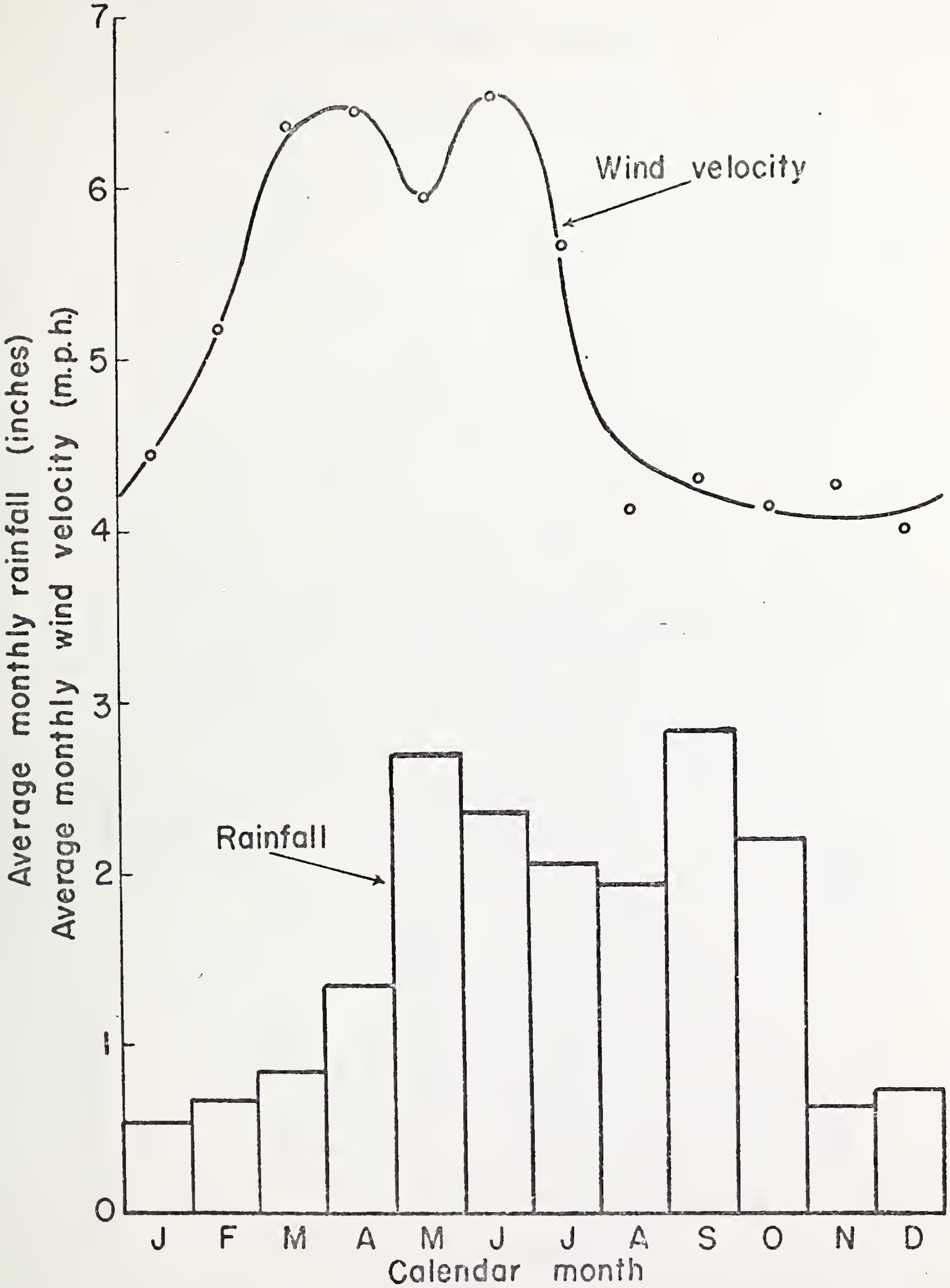


Figure 1.--Average rainfall and wind movement by calendar months, 1930-52, at the Texas Agricultural Sub-station 8 east of Lubbock.

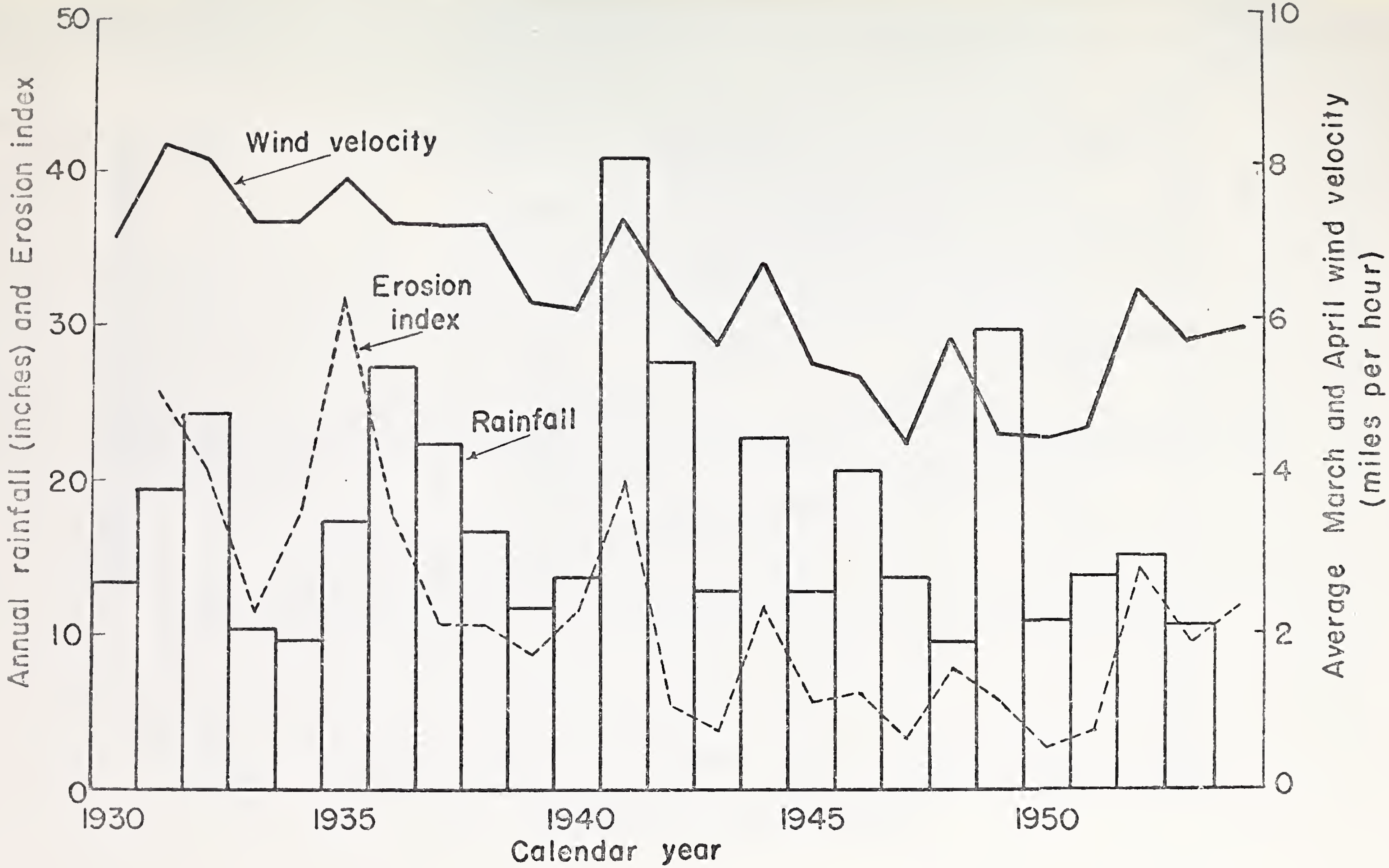


Figure 2.--Rainfall, wind velocity, and erosion index, 1930-54. Data from Texas Agricultural Sub-station 8 east of Lubbock.

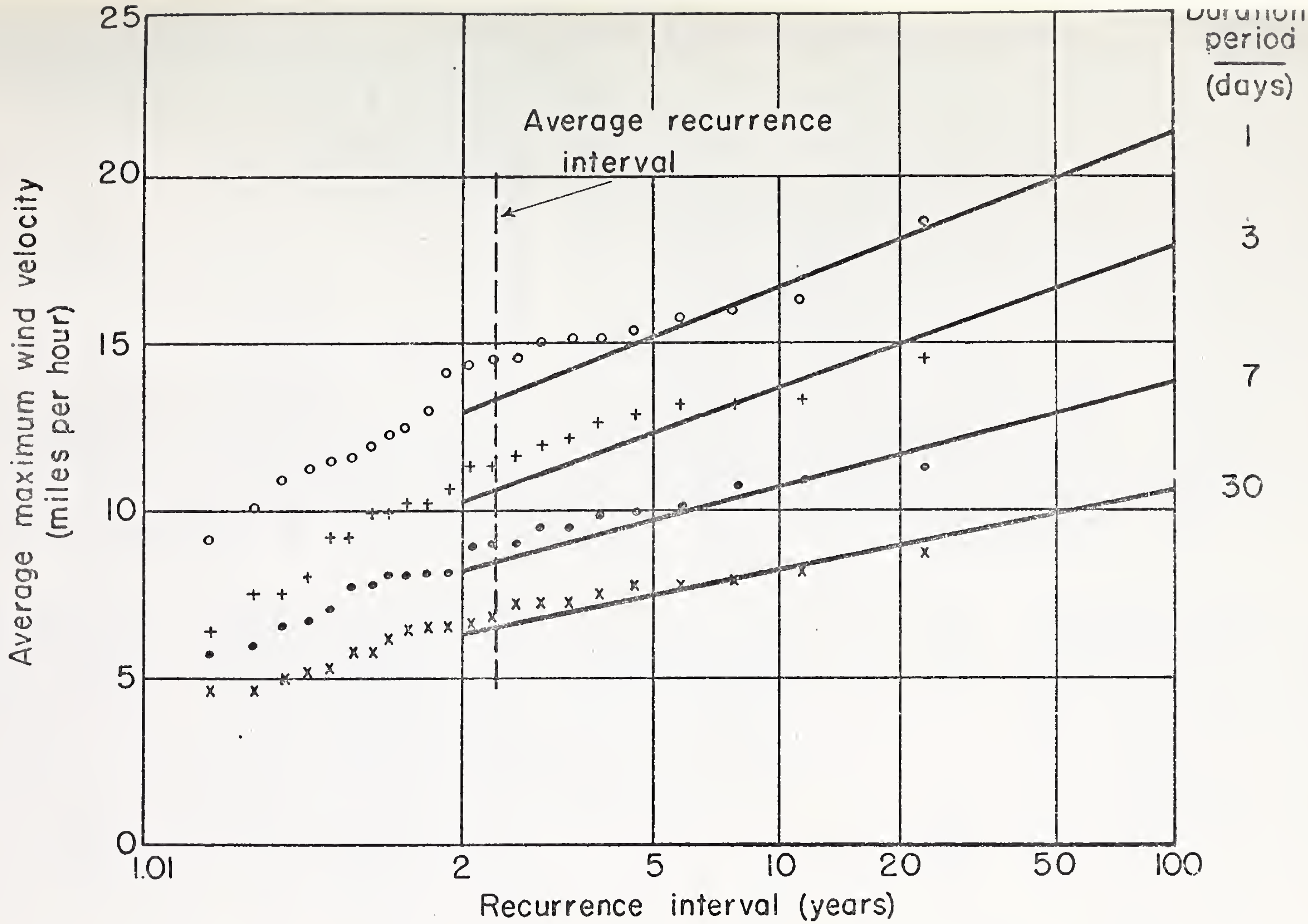


Figure 3.--Intensity-frequency data for wind movement during month of April from 1930-52. Data from 4-foot height gage at the Agricultural Sub-station near Lubbock.

Index of erodibility associated with soil structure.--Figure 4 shows the relation of the amounts of soil eroded from 5-foot-long trays to the percentage of surface soil material less than 0.84 mm. in diameter. These losses are relatively small compared with those obtained from the 90-square-foot area of the portable wind tunnel, where a surface wind force of 3,000 pounds per acre was used instead of the 406 pounds per acre used on the trays. However, previous research has indicated that the shape of the curve will be similar for the two conditions.

The amounts of loss from trays or from the whole area of the tunnel serve merely as a relative measure of erodibility. A different tunnel than the one used, no doubt, would produce different amounts of erosion even under apparently the same wind force. The amount of soil eroded under the same wind force in the field also varies with the dimensions of the field, geographic location, and many other factors. Consequently, the actual amounts of soil moved by wind have little significance so the authors decided to express soil erodibility in dimensionless terms applicable under all circumstances. This was done by transposing the amounts of soil loss to soil erodibility index I (table 2, p. 26). Index I is equal to $\frac{x(E)}{x(E)_{70}}$, where $x(E)$ is the amount of soil eroded with a variable amount of dry erodible soil fraction less than 0.84 mm. in diameter, determined with either the automatic rotary sieve or the hand-rotary sieve; and $x(E)_{70}$ is the amount of soil eroded under the same conditions when the proportion of fraction less than 0.84 mm. is 70 percent.[5] Index I of table 2 is multiplied by 10 merely for convenience.

Residue-roughness relationships.--In the New Mexico study (14), soil eroded from the tunnel was found to bear an approximate inverse relationship to RK, where R was the dry weight of surface residue in pounds per acre and K was the ridge roughness equivalent in inches.

For a given value of R, K has a range of values dependent upon the type and orientation of residue. Figure 5 indicates the average relationship based on standing stubble only, that is, on stubble not tilled since the crop was harvested. Where tillage knocked down the residue but did not appreciably affect the roughness of the soil surface, as obtainable with a one-way disk, the values of K were much lower for comparable values of R. Figure 5 shows 100 is an approximate minimum obtained in the field for the product RK.

Wind-velocity reductions near the soil.--Different degrees of cover and roughness of a soil surface will give different distributions of wind velocity above the surface, and the pattern of wind velocities tends to remain the same over a given surface regardless of the velocity. Ratios will bring out differences between different surfaces. Here, it is convenient to use the velocity in the center of the 36-inch square duct as a basis for comparison. Thus, the velocity at any height above the surface may be expressed as a ratio of the velocity in the center of the tunnel, $\frac{V}{V_c}$, where V is the velocity at any height and V_c is the velocity 18 inches above the soil surface in the center of the tunnel.

Figure 6 shows the velocity distributions, $\frac{V}{V_c}$, obtained at different heights over four sites. The distribution above the surface of site 4 was obtained after removing all residue and leveling the soil.

If we consider the relative velocities at a 1-inch height, they are as follows:

Site No.	Relative velocity	Reduction in relative velocity creditable to cover
	$\frac{V_1}{V_c}$	$100\,(1 - \frac{V_1}{V_c}/0.575)$
	Ratio	Percent
4 (bare, smooth soil)	0.575	0
10 (865 lbs./acre sorghum residue)	.370	36
2 (1,890 lbs./acre sorghum residue)	.190	67
1 (2,275 lbs./acre sorghum residue)	.060	90

The percentage reduction in relative velocity at the 1-inch height is calculated from the ratios $\frac{V_1}{V_c}$ as shown in the tabulation. Similar values of velocity reductions at the 1-inch height are given on pages 31 to 60 for all wind-tunnel test sites.

Force taken by cover above 1-inch height.--The percentage of the total wind force taken by the cover above a height of 1-inch also may be calculated from the velocity ratios $\frac{V_1}{V_c}$. Force is proportional to velocity squared. The percentage of wind force bearing on the cover above a 1-inch height is as follows:

$$\%\ \text{force} = 100\left[1 - \left(\frac{V_1}{V_c}/0.575\right)^2\right]$$

where $\frac{V_1}{V_c}$ is the velocity ratio at a 1-inch height above any surface and the ratio 0.575 is the value of $\frac{V_1}{V_c}$ over a smooth, bare surface, such as site 4. Calculations will demonstrate that the cover on sites 10, 2, and 1 is capable of taking 59, 89, and 99 percent of the wind force, respectively. Similar values for all sites on which the tunnel was used are given on pages 31 to 60.

[5]See footnote 4.

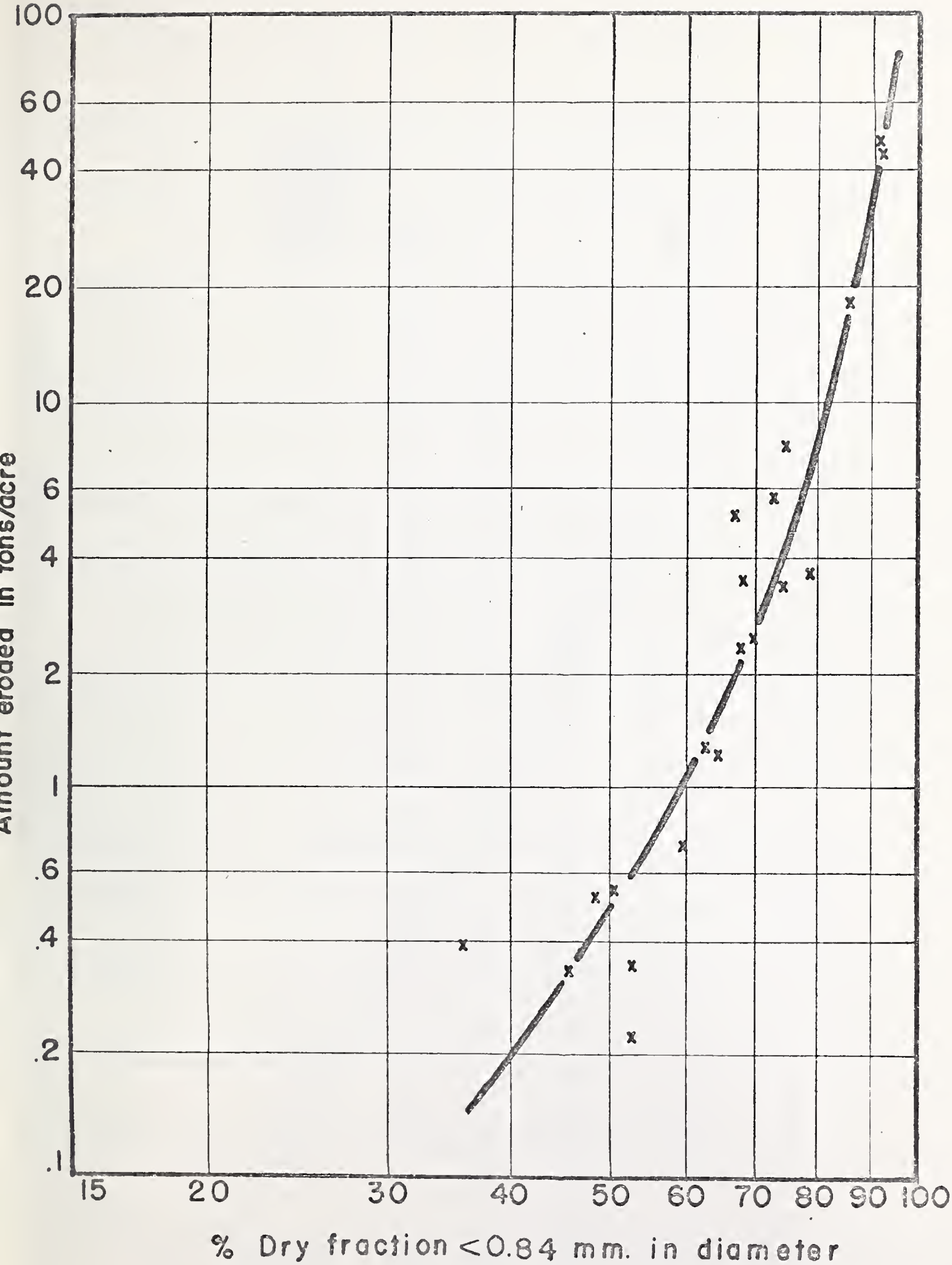


Figure 4.--Relation of soil losses from 5-foot wind-tunnel trays to the proportion of dry-soil fractions less than 0.84 mm. in diameter.

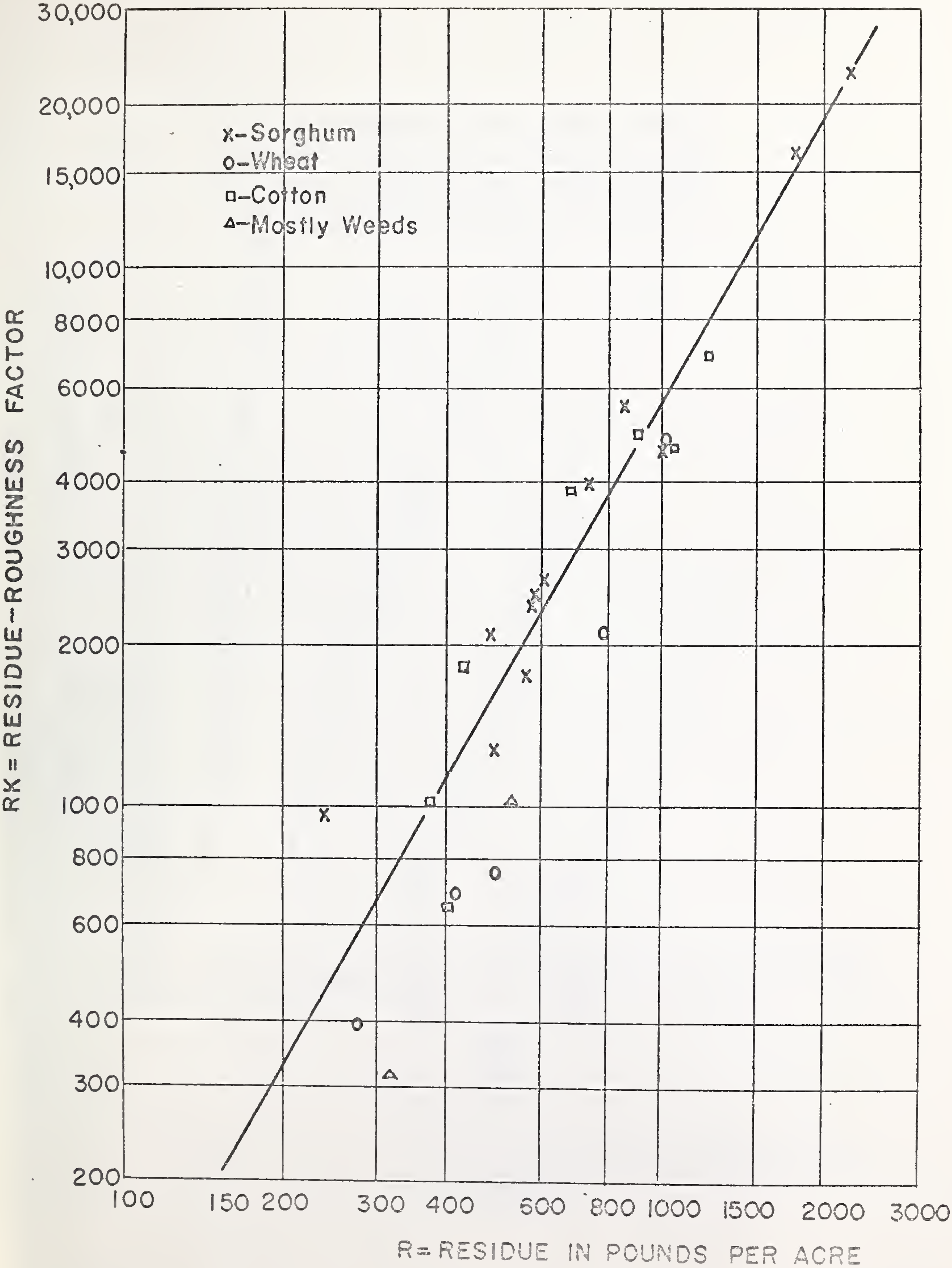


Figure 5.--Relationship of RK, the residue roughness complex, to the amount of residue on land untilled since the growth of the last crop.

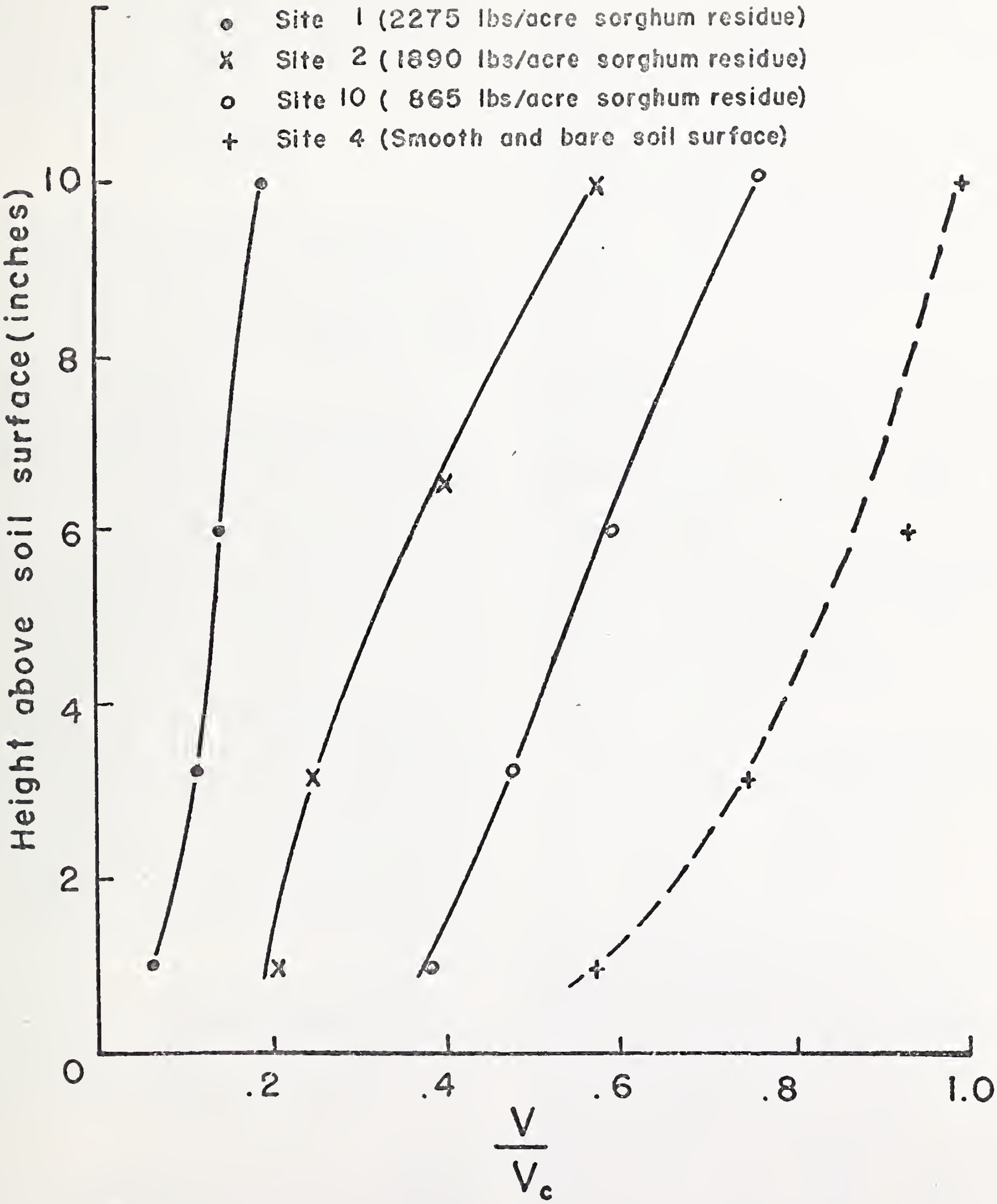


Figure 6.--Relative velocities measured at four heights above the soil surface for various cover conditions.

The percentage of wind force taken by the cover above a height of 1 inch appears to bear a fair relationship to the value of *RK* (fig. 7).

Measured soil losses in relation to surface variables.--An equation expressing the relationship among the measured variables was determined by the multiple regression method. All wind-tunnel data, except sites 9 and 11, were used. The equation derived is:

$$X = 3{,}302 \ \frac{10\,I}{(RK)^{1.41}} \qquad (1)$$

where X is the measured soil loss in tons per acre, $10\ I$ is the dimensionless soil-erodibility index for any percentage of surface material less than 0.84 mm. in diameter (table 2, p. 26), R is the weight of surface residue in pounds per acre, and K is the ridge roughness equivalent in inches. Figure 8 shows the correlation between measured and calculated soil loss.

Estimation of erodibility of farm fields.--Equation (1), based on soil losses measured in the wind tunnel, may be used for estimating the relative erodibility of farm fields. Some idea of the accuracy that can be expected from such estimations may be obtained from the degree of deviation of individual measurements of erodibility from the curve in figure 8. The coefficient of correlation between the measured and the estimated soil losses (table 1, p. 26) is 0.803. This is highly significant, since the required value at a 0.1-percent level is 0.597.

Where a large number of cases is involved, some simple method of estimating the relative erodibility is expedient. The alinement chart (fig. 9) is prepared to facilitate the estimations. Erodibility X is read as follows: A straightedge is passed through the percent value of erodible soil fraction less than 0.84 mm. in diameter on line *AB* and through the value of *RK* (the product of residue in pounds per acre and ridge roughness equivalent in inches) on line *EF*. The erodibility value corresponding to these conditions lies at the point where the straightedge crosses line *CD*.

Example: Let it be assumed that the proportion of erodible fraction is 83 percent and the product *RK* is 1,500. Erodibility X will be found at the point where a straight line joining these two values crosses *CD*; or, in this case X is 4.4 tons per acre.

The alinement chart can be used similarly to determine the amount of crop residue required to reduce erodibility to any level, if the proportion of erodible soil fraction and the ridge roughness equivalent are known:

Thus, if a soil contains 83 percent erodible fraction and erodibility is desired to be reduced to an insignificant amount of 0.25 ton per acre, then a straightedge connecting these two points will cross line *EF* at 11,500, the required value of *RK*. The amount of crop residue R when $RK = 11{,}500$ is shown in figure 5 to be 1,500 lbs./acre.

This is the residue required if the soil surface is essentially smooth, as it would be before the stubble is worked. In this case the ridge roughness equivalent is $\frac{11{,}500}{1{,}500}$, or 7.7 inches. If ridge roughness equivalent is other than 7.7 inches, the amount of required crop residue would be different to the extent that when these two factors are multiplied their product is 11,500.

If surface roughness and amount of surface residue are known, the alinement chart also can be used to estimate conveniently the degree of soil cloddiness (clods greater than 0.84 mm. in diameter) required to reduce erodibility to any level.

The alinement chart and the equation (1), from which the chart is derived, are applicable only to conditions under which the wind-tunnel tests were conducted--generally on loose, noncrusted soils. Under other conditions, the relationship among the estimated variables might be considerably different. The alinement chart was held within reasonable limits of the data available from this study.

Tentative methods of estimating the proportion of erodible soil fractions, the amount of crop residue, and the ridge roughness equivalent are described in another report.[6]

A wind-erosion classification based on erodibility X may be made as follows:

Erodibility value X	Erodibility	Basis of classification
< 0.25	Insignificant	Soil is sufficiently protected by clods, ridges, or vegetative cover to make it essentially nonerodible.
0.25 - 5.0	Slight to moderate	Soil is only partly protected from erosion.
> 5.0	High to very high	Soil is highly erodible and its surface is virtually unprotected from wind.

Soil Characteristics Influencing Wind Erosion

Cloddiness of the dry soil, or dry aggregate structure, is the primary factor influencing erodibility by wind. A number of factors influence the clod structure and, consequently, the erodibility. Some of these are soil texture, kind and amount of organic matter, water stability of the clods, amount of free calcium carbonate, seasons, and the different cropping and tillage practices. This study was undertaken to evaluate some of these factors. Detailed data obtained on 32 different sites are included in tables 3, 4, and 5, pages 27 to 29. Figures and condensed tables have been prepared to show more clearly the effects of the various factors. Sites 1 to 30 are described, along with photographs, on pages 31 to 60 and sites 31 to 40 are described in table 6, page 29.

[6] See footnote 4.

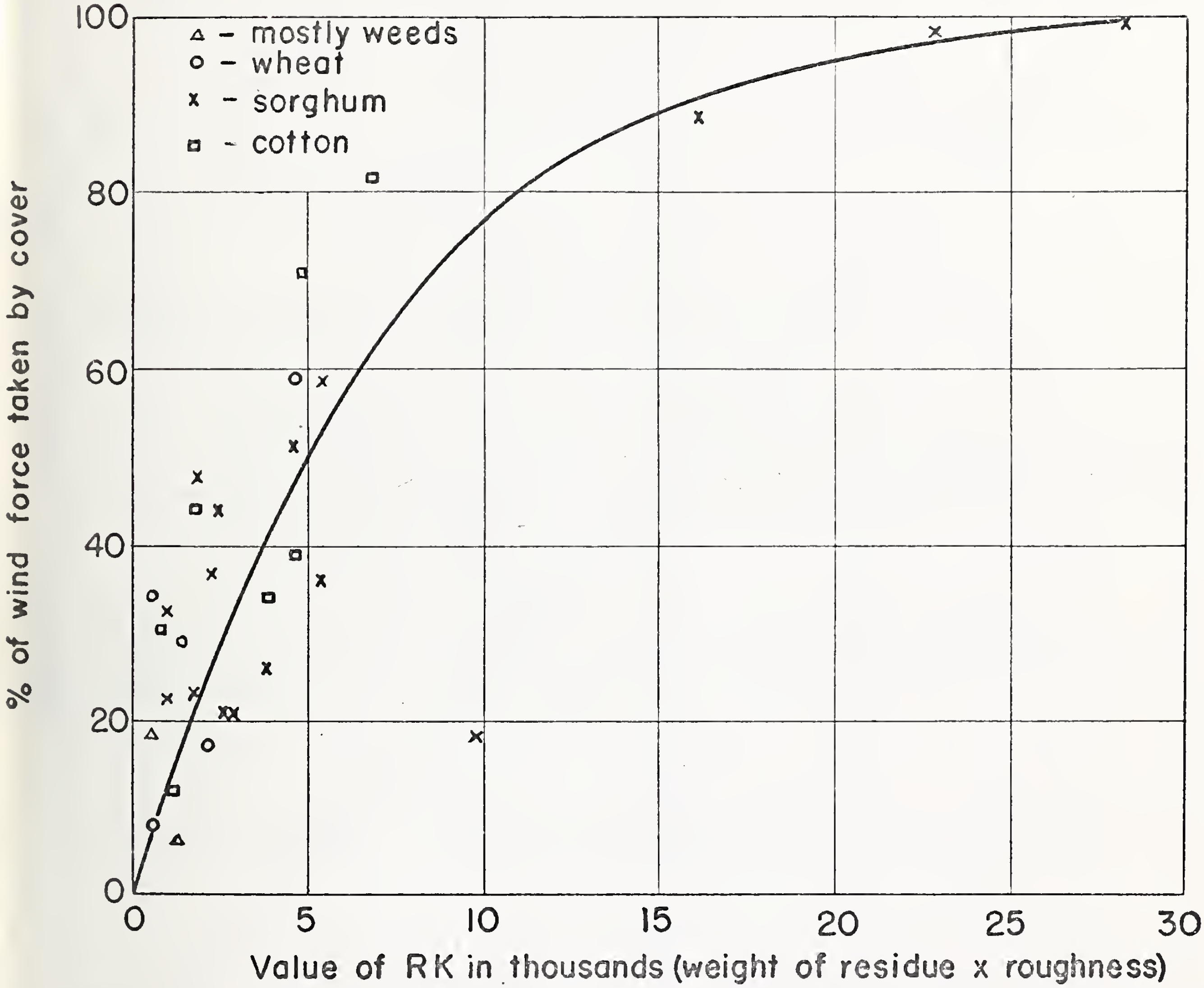


Figure 7.--Percentage of wind force taken by cover in relation to RK.

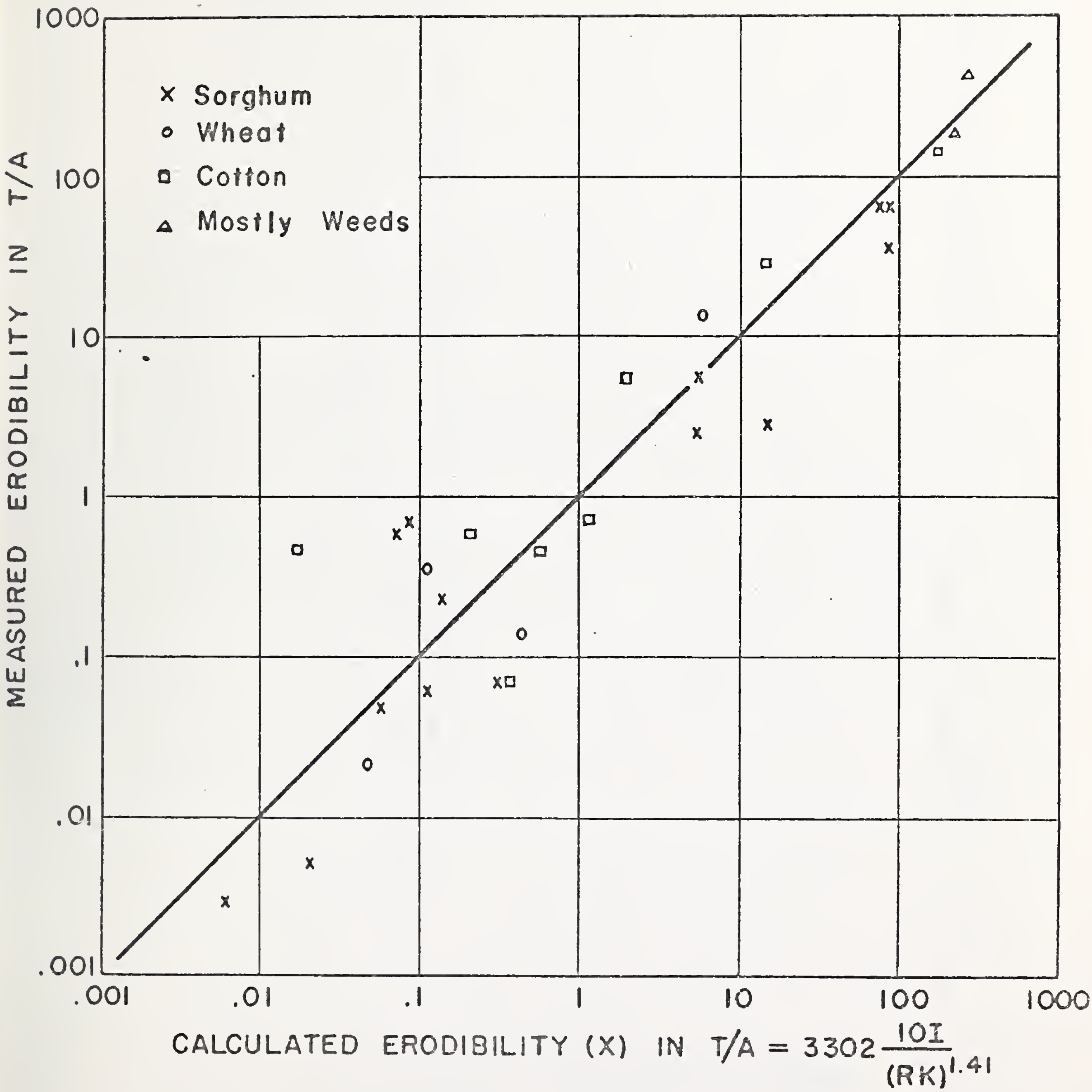


Figure 8.--Correlation between measured and calculated erodibility.

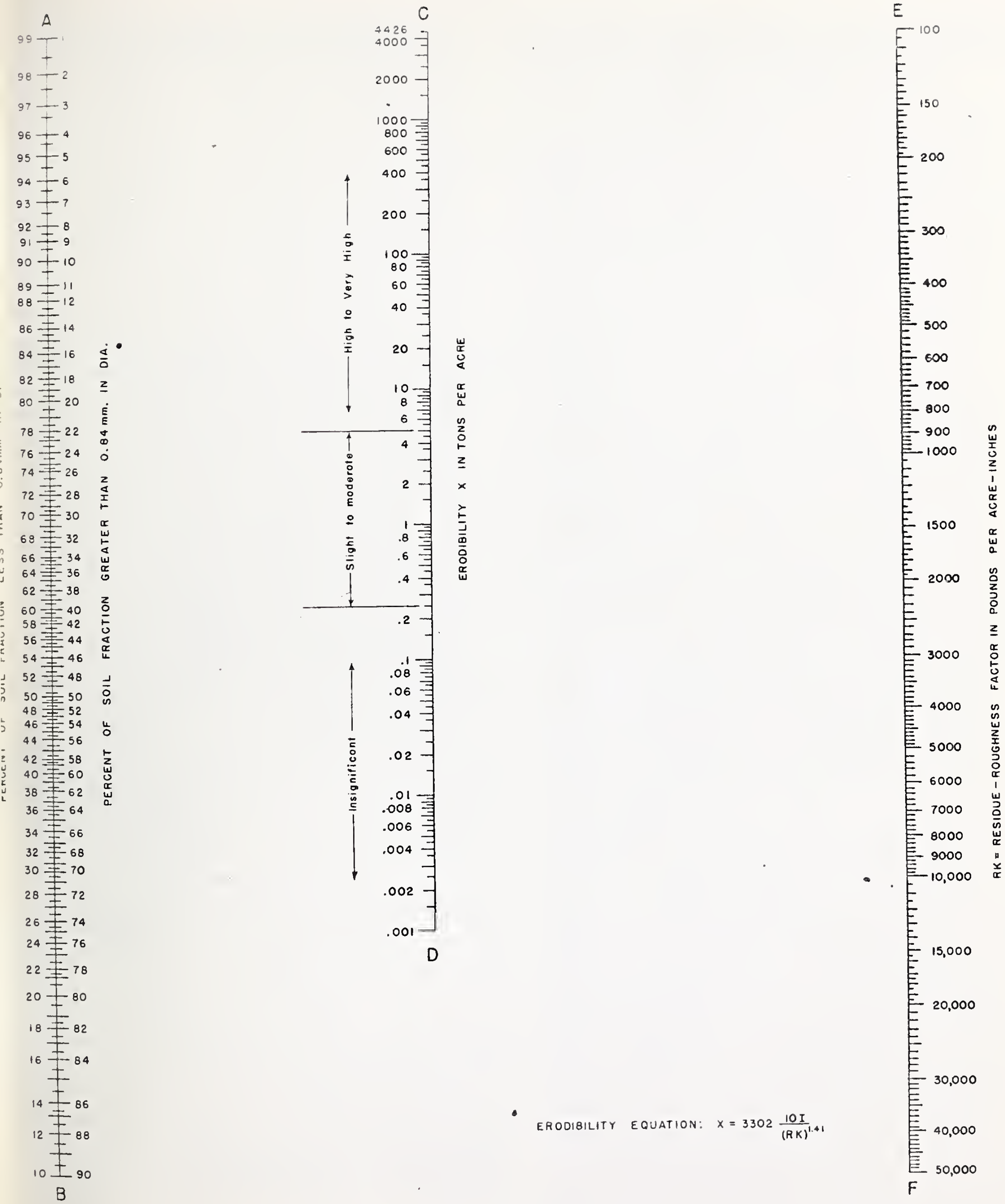


Figure 9.--Alinement chart for estimating erodibility from existing conditions of soil cloddiness, surface roughness, and crop residue. The chart can also be used for estimating the amount of crop residue, degree of surface roughness, and/or degree of soil cloddiness required to reduce erodibility to any level within its limits.

Relation of erodibility to soil cloddiness.--A definite association exists between the proportion of erodible soil fraction less than 0.84 mm. in diameter and the amount of soil material eroded (fig. 4). The data indicate a similar relationship between the highly erodible fraction less than 0.42 mm. and the amount of soil eroded. Either or both of these fractions serve equally well as indicators of erodibility by wind. The cloddiest soils have the lowest proportion of highly erodible and semierodible fractions and, therefore, are least erodible. A negligible amount of erosion (0.1 ton per acre) occurs when the soil contains about 30 percent of the fraction less than 0.84 mm. in diameter (fig. 4). Soil containing less than this amount of erodible fraction may be considered nonerodible.

The highly erodible and semierodible fractions have been used successfully as indicators of erodibility of soil by wind (2, 9). Although they are not the only primary factors that influence erodibility, they are by far the most important. The influence of other factors is cancelled to some degree by opposing trends and by relatively large inherent errors of estimation. These minor factors are the primary reason for a certain amount of deviation of individual values of erodibility from the average values (fig. 4). Despite some error of estimation, however, it is possible to determine by dry sieving the approximate relative erodibility of soils by wind.

The influence of depth on clod structure and erodibility.--Cloddiness increases appreciably with depth in all soils. Inversely, the amount of erodible fraction less than 0.84 mm. decreases with depth (fig. 10, left). The erodible fraction decreased to 30 percent at depths of about 3 inches in loam, clay loam, and sandy clay loam, 5 inches in sandy loam, and 12 inches in loamy sand. Soil structure below these depths may be considered nonerodible, even if only temporarily. It is evident from these data that loamy sand would have to be plowed much deeper than loam to produce equal cloddiness of the surface soil.

The influence of soil texture on clod structure and erodibility.--On the average, loamy sand was more than 8 times more erodible than sandy loam, and more than 40 times more erodible than the finer-textured soils (loam, clay loam, and sandy clay loam) (fig. 10, right).

The clay fraction is the main soil constituent that governs the erodibility by wind. Loamy sand has the least clay and the largest proportion of erodible fractions, sandy loam has more clay and fewer erodible fractions, loam and clay loam have the highest content of clay and the lowest proportion of erodible fractions in the first inch of soil (fig. 11). A comparable relationship between clay and erodible fractions is found at lower depths, although it is on a different general level.

Variations in soil texture, structure, and erodibility with depth.--The percentage of clay increases with depth in all soils (fig. 12, left). Below the cultivated zone, an increase of clay with depth is due to the well-known illuviation and weathering processes that occur to a certain degree even in the so-called "dry" regions. Within the cultivated zone, however, the texture would tend to be uniform if no erosion occurred.

As a result of wind erosion, silt and clay often are removed from the surface of the soil, and the sand is left behind. This sorting action is extremely harmful in dryland areas, especially on coarse-textured soils. Whenever plowing is performed, the mantle of sand is buried, some clods are brought to the surface and erosion is decreased, at least temporarily. As soon as clods are disintegrated by tillage and weathering, erosion sets in, the silt and clay fractions are removed, and the land becomes sandier than ever. Practices such as deep plowing to control wind erosion are temporary expedients unless they are supplemented with more permanent methods, such as irrigation.

Soil conservation in the face of wind erosion in dry regions is specifically the conservation of clay and organic matter. Both are associated closely and tend to be removed simultaneously. The greater the amount of clay in the soil, at least up to about 30 percent, the lower is the erodibility (fig. 12, right). Hence, the longer the soil has been exposed to wind erosion the more sandy and the more erodible it will be.

It is evident from the data obtained, however, that a decrease in erodibility of the soil from lower depths is not altogether due to the increase in clay. Soils having a uniform texture with depth have a much higher proportion of erodible fractions at the surface than at lower depths. The increased cloddiness with depth is due in great measure to the force of compaction. The lower the depth, the greater is the degree of compaction, the less the degree of disintegration of structure by forces of the weather, and the lower the erodibility of the soil.

Soil compaction is the cause of several serious soil problems. It decreases soil permeability, increases erosion by water, decreases root penetration, and reduces the productive capacity of the soil. The ideal, of course, is a loose soil bed composed of compact soil aggregates that possess sufficient stability against the three main disintegrating forces: weather, tillage implements, and erosion. In dryland areas, however, soil compaction may be turned into a benefit by deep tillage with appropriate implements. Such implements would have to break up the compacted zone, bring compact clods of appropriate size to the surface, and retain crop residues on the surface of the ground. This would tend to increase soil permeability, decrease erosion by wind and water, increase root penetration, and thereby increase the productive capacity of the soil.

The compacted clods are softened and in time become disintegrated by the forces of the weather. The process of compaction goes on all the time at lower depths, however, so that more stable clods may be brought up periodically as part of a general routine of farming.

Mechanical stability of soil clods.--The ability of clods to resist breakdown by mechanical forces,

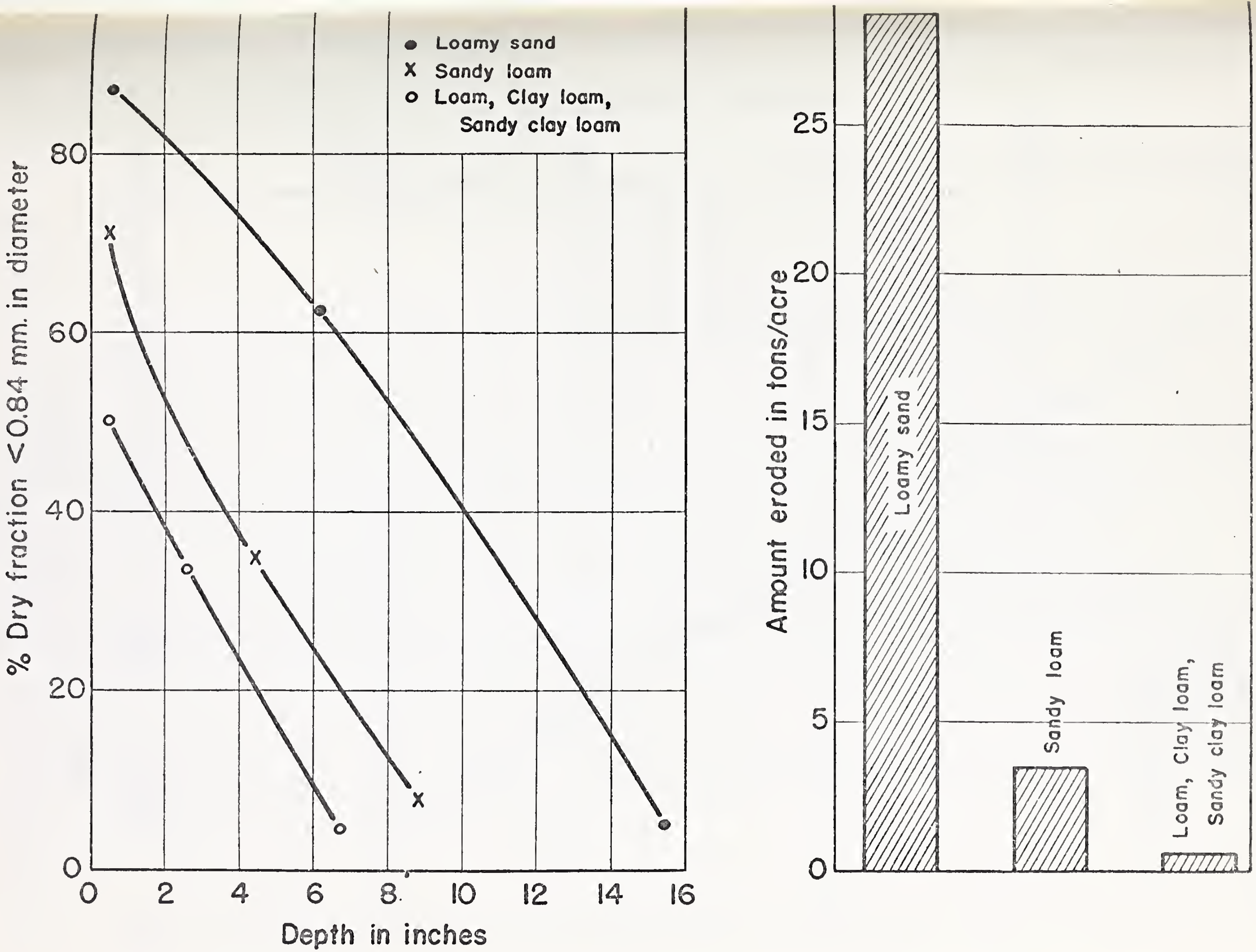


Figure 10.--Proportion of erodible soil fraction at different depths and amounts eroded from different soil classes.

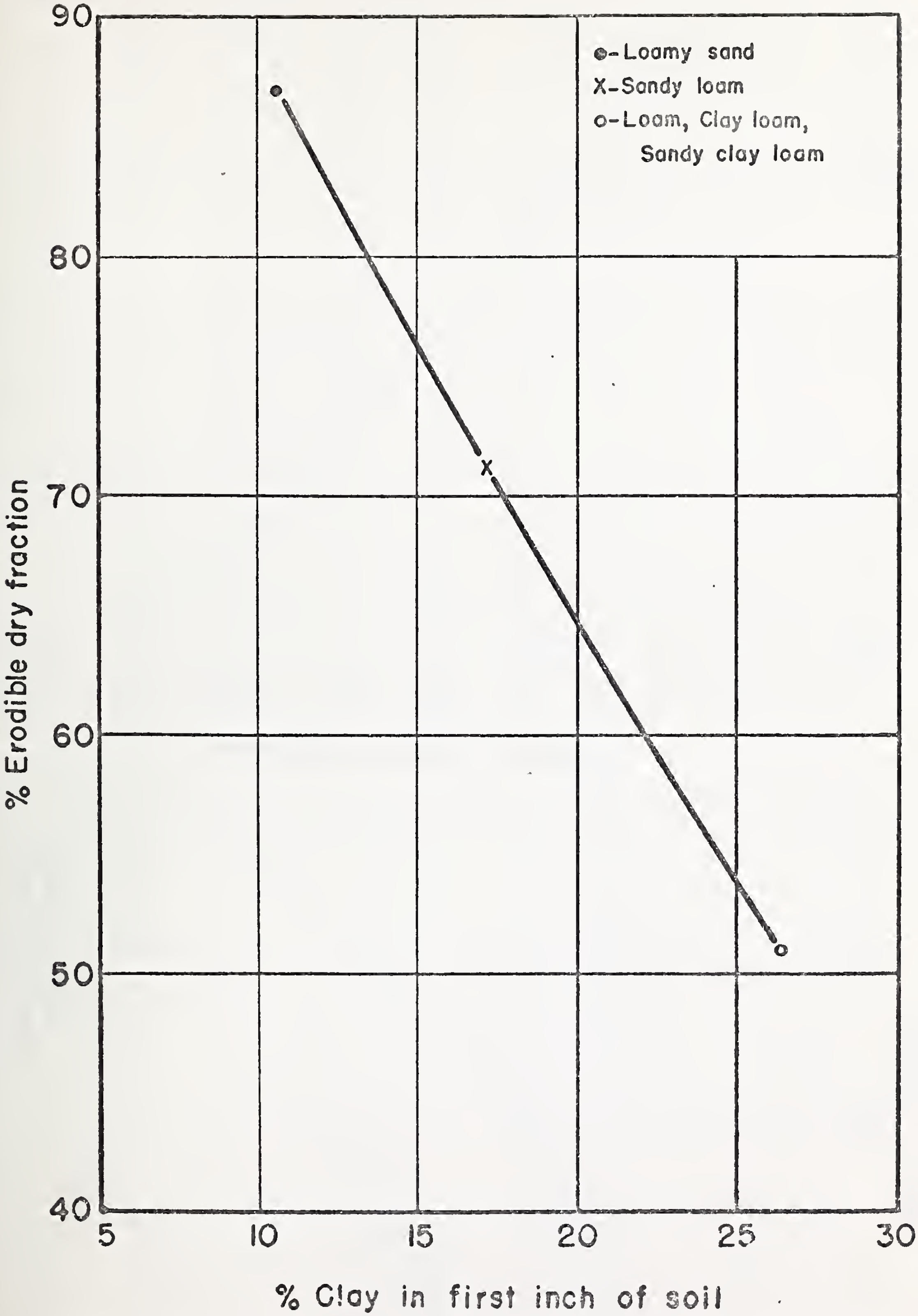


Figure 11.--Relation between the percentage of erodible soil fraction and the percentage of clay in the upper inch of soil.

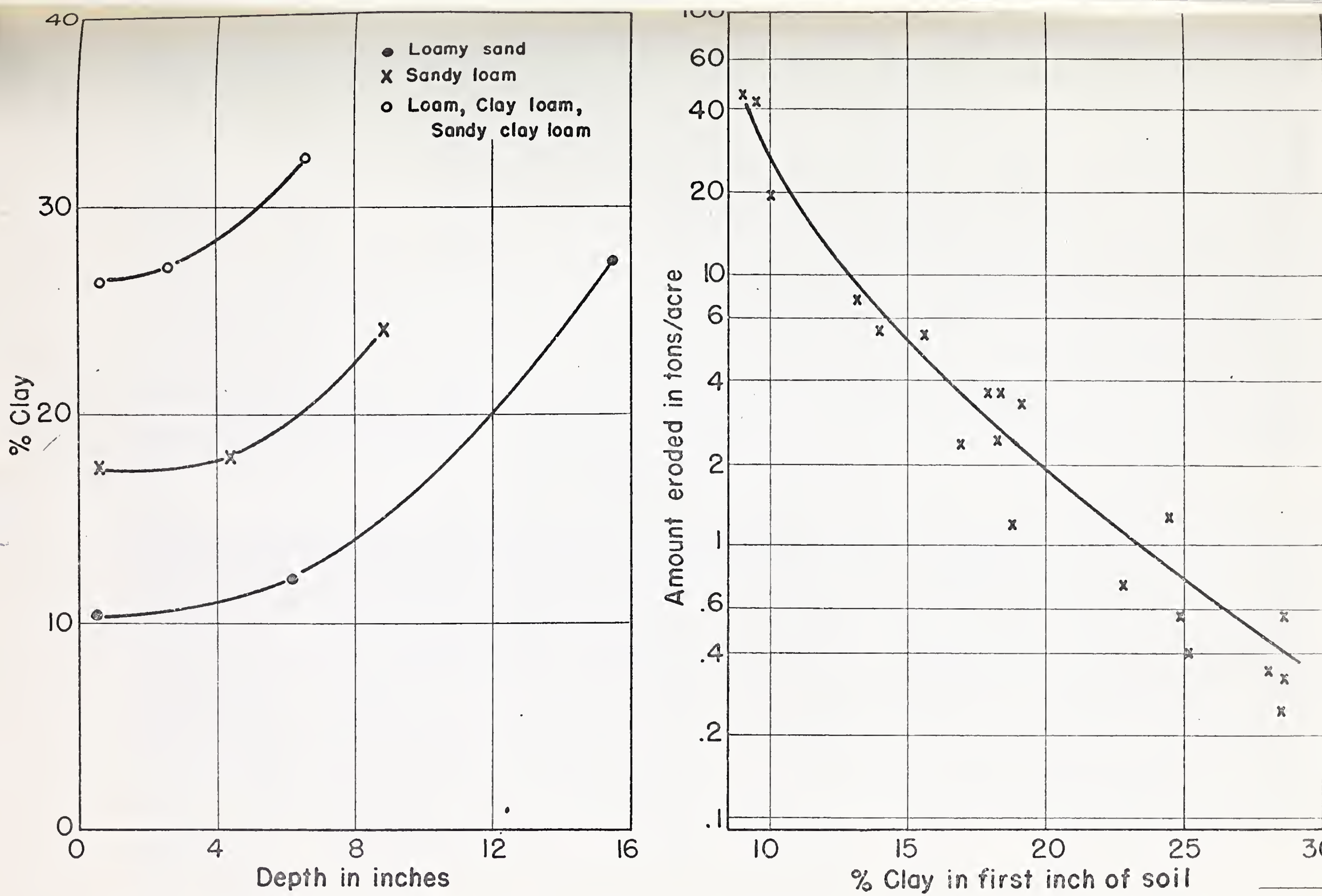


Figure 12.--(Left), Percentage of clay in various soils at different depths. (Right), Amounts eroded in relation to the percentage of clay.

known as mechanical stability, varies directly with the ability of the clods to resist disintegration by abrasive action of drifting soil. This abrasive action is one of the most serious aspects of erodibility by wind. The mechanical stability as determined by repeated dry sieving in this study is an indicator of the relative abradability of clods at various depths and on different soils.

Mechanical stability of clods greater than 0.84 mm. in diameter increases with depth in all soils (fig. 13). It also increases with the fineness of soil texture, that is, with percentage of clay. Thus, the coarsest soil (loamy sand) has the lowest mechanical stability and clay loam the highest at corresponding depths. It is apparent, however, that the increased mechanical stability of clods, as well as increased cloddiness, with depth is due partly to the increased amount of clay and partly to the degree of soil compaction. The lower the depth, the greater are the degree of compaction and the mechanical stability of the clods.

The influence of water-stable structure on cloddiness and erodibility.--The resistance of soils to wind action appears to depend primarily on their ability to form massive secondary aggregates or clods. Most of the soils analyzed contain an exceedingly small proportion of water-stable particles or aggregates of the size not erodible by wind, that is, greater than 0.84 mm. in diameter (table 3, p. 27). In 19 of the 21 cases analyzed, they did not exceed 3 percent in the surface soil. The amount of semierodible water-stable grains (0.42 to 0.84 mm.) was a little greater, but in no case did it exceed 10 percent. In the great majority of cases, the amount was much less than 10 percent. At lower depths, the amounts of semierodible and nonerodible water-stable fractions were somewhat greater. Evidently, these water-stable fractions broke down somewhat when exposed to the forces of the weather near the surface. These dryland soils apparently lack sufficient amounts of coarse water-stable grains or aggregates to resist the wind, and no feasible method has been found to form and maintain them in the desired quantities.

The influence of calcium carbonate (lime) on soil structure and erodibility.--An accurate evaluation of the influence of free calcium carbonate, or lime, on soil structure and erodibility is extremely difficult to make in the field. Sites exactly alike in texture and other characteristics, but varying in lime, are almost impossible to find. The lime itself has some influence on soil texture. However, an attempt was made to compare some structural characteristics and the erodibility of two soil series high in lime (Mansker and Drake fine sandy loam) with one series low in lime (Amarillo fine sandy loam). The soils did not contain exactly the same amounts of clay. Since clay has an important influence on the proportion of erodible fractions, an appropriate correction for its effect was made on the basis of the percentage clay content equal to that in the corresponding high-lime soil. This correction was made in accordance with figure 12 and erodibility was determined from table 2, page 26.

The high-lime soils contained an appreciably greater proportion of erodible soil fractions than the soil of similar texture with only a trace of lime, and were at least twice as erodible (table 7, p. 30). The high-lime soils differed in erodibility also, the soil containing about 3 percent of lime being more erodible than soil containing about 6 percent of lime. These results substantiate, in general, the more detailed study conducted previously on this subject (4).

The mechanical stability of clods in the high-lime soils appeared to be lower than those in the low-lime soil. It is evident that softening or loosening of soil clods by lime is followed by their partial disintegration to sizes of fractions erodible by wind.

Effects of seasons.--Attempts to evaluate seasonal influences on crop residues, soil structure, and surface roughness were made on fields undisturbed by cultivation from fall 1952 to spring 1953. Only two such fields were available for study, site 12 in wheat and site 5 in sorghum stubble.

The amount of crop residue on site 12 was greater in the spring than in the previous fall, due to growth of wheat (table 8, p. 30). The amount of sorghum residue on site 5 decreased, some of it evidently being destroyed by decomposition. Some stubble was flattened by wind and lost part of its effectiveness in protecting the soil.

The proportion of erodible soil fractions (table 8) and the ridge roughness equivalent of the two fields changed little from fall to spring. Soil structural disintegration usually occurs during the winter months (7), due to freezing and thawing, but the winter of 1952-53 was unusually mild and dry and had little influence on soil structure. There appeared also to be little change in soil structure during the winter of 1953-54, but some change was noted in the mechanical stability of soil clods, especially those at or near the surface. The clods were softer in the spring and were more readily broken by crushing or sieving. Where the soils were undisturbed by tillage, mechanical stability increased appreciably with depth (table 8).

Influence of tillage and harvesting implements.--In the fall 1952 and spring 1953 study, 19 of 21 fields received tillage treatment in the early spring. Eleven fields were listed and 8 were chiseled. The height of most of the lister ridges was about 10 inches; the height of chisel ridges varied.

In all but 4 fields, the proportion of erodible soil fraction less than 0.84 mm. in the surface inch of soil was lower in the spring than in the fall. This was due primarily to bringing clods to the surface through tillage, since tillage decreased erodible fractions at the surface in each of the 3 textural groups of soil (table 9, p. 30). Apparently, the proportion of erodible fraction would have remained much the same if the land

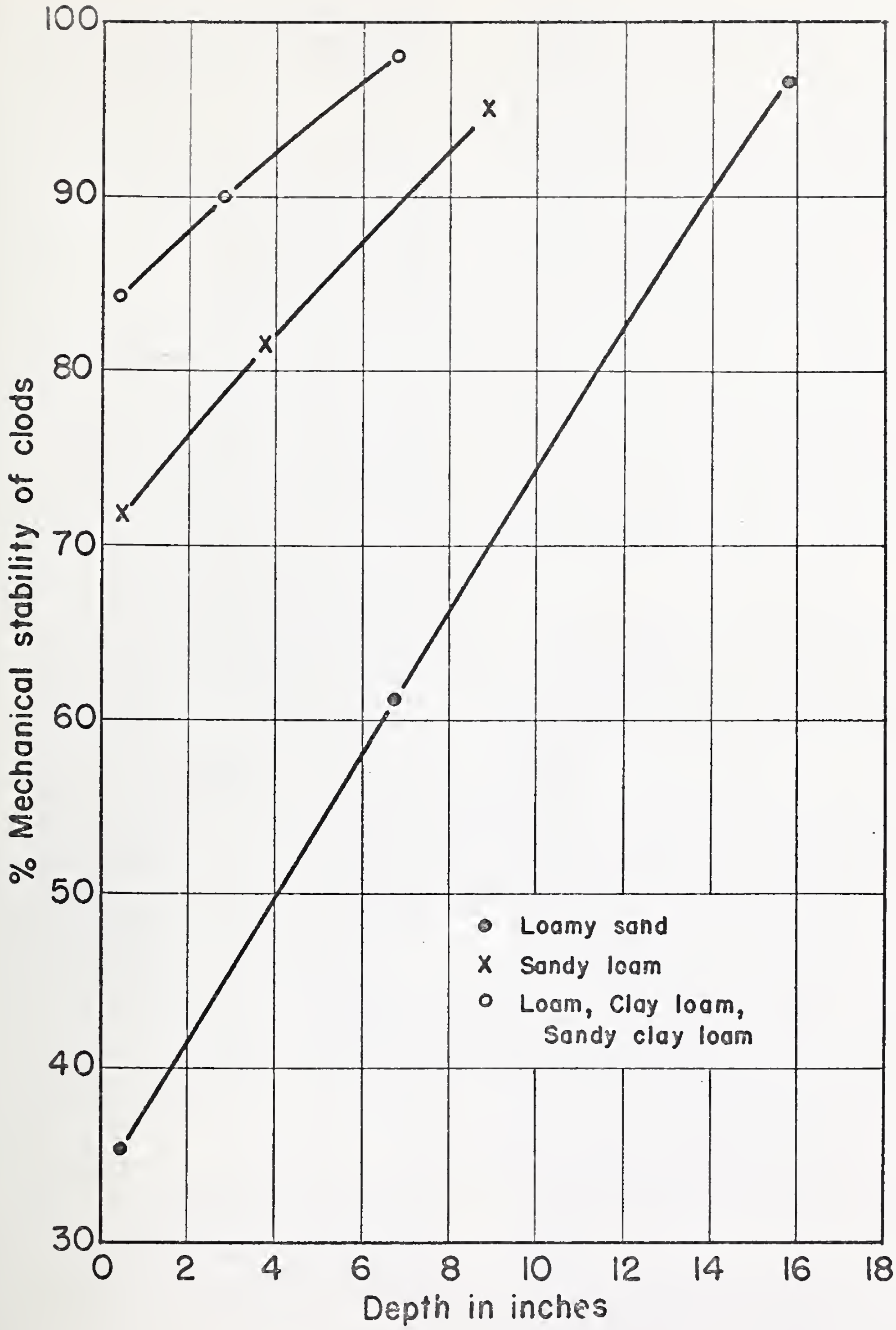


Figure 13.--Mechanical stability of clods of various soil classes at different depths.

had not been tilled. On an overall basis, however, soil erodibility was not reduced as much as the change in the proportion of erodible fractions would indicate. Tillage also buried or flattened much of the crop residue, which tended to increase erodibility.

A lister was more effective than a chisel in reducing the amount of erodible material at the soil surface and in increasing the surface roughness, but it buried a greater proportion of crop residue (table 9). Whether listing or chiseling was more beneficial in reducing erodibility depended on the kind of soil, soil structure, roughness, and crop residue existing before the tillage operation. If the amount of crop residue was low (less than 500 pounds per acre), listing generally was beneficial in reducing erodibility; if the crop residue cover was good, listing sometimes increased the erodibility. Generally, therefore, listing was beneficial on coarse-textured soils where the amount of crop residue afforded poor protection, but chiseling was the better on fine-textured soil where residues were more abundant.

Mechanical cotton harvesting equipment pulverized from 40 to 70 percent of the surface crust and, therefore, considerably increased the susceptibility of soil to erosion by wind. These effects could not be measured entirely by dry sieving but are plainly indicated in photographs of sites 13, 14, 15, and 18. Handpicked cotton land was less erodible (site 7) but seldom contained enough residue to assure adequate protection against wind.

The influence of deep plowing. --Sites 33 and 34 were plowed 17 and 14 inches deep, respectively, in 1950, and site 35 was plowed 14 inches deep in 1952 to control wind erosion. These sites are fairly close together on the Terry County Experiment Station at Brownfield, Tex. The soil is loamy fine sand. Sites 31 and 32 on the same soil were not deep plowed and provided a check for evaluating the effects of deep plowing.

The surface soil on site 35, plowed in the spring of 1952, was reasonably cloddy in November 1952, but the surface soil on sites 33 and 34, plowed in 1950, was in a highly erodible condition at the time of testing (fig. 14). The soil on the unplowed land on sites 31 and 32 was still more erodible, however, than that on any of the deep-plowed fields.

Conditions on the plowed and unplowed land were reexamined in the spring of 1953 (table 4, p. 28), when drift accumulations about 6 inches deep and blowouts were found throughout both the plowed and unplowed plots. The effects of deep plowing were thus obliterated. Therefore, more isolated fields were chosen for this study in December 1953.

Table 5, page 29 (sites 14, 16, and 26) gives the results of the December 1953 study of deep plowing. Erodibility of deep-plowed Amarillo loamy fine sand on sites 14 and 16 was only 1.7 and 15.4 percent, respectively, of that on site 26 which was not deep plowed. Deep plowing, on the average, increased the clay content of the surface soil from 5.7 to 10.4 percent and decreased the sand content from 90.9 to 80.9 percent. The results, in general, substantiate those obtained at the Terry County Experiment Station in fall 1952. They indicate that the deep-plowed soil, although less erodible than the unplowed land, is still potentially highly erodible; and, unless the soil is protected from wind erosion, the beneficial results of deep plowing can be nullified rapidly by the sorting action of erosion.

Large clods brought to the surface by plowing apparently tend to disintegrate within a year or two after the operation. The real significance of the plowing is the bringing up of the clayey soil material from below to increase soil productivity. The more clayey soil will, no doubt, maintain a cloddier and less erodible structure as long as no soil drifting occurs. But if stability of the surface is not maintained after deep plowing, beneficial results from the practice are short-lived. Continued drifting of the surface will eventually bring about a condition where clayey material is not within the reach of further deep plowing. The resulting deep mantle of sand will then tend to be more hazardous than the initial shallower mantle.

Summary

Many factors are associated with the erosion of soil by wind. They can be grouped under three major categories: climate, soil, and vegetative cover. This study was conducted to gain some information on these various factors, particularly as they relate to specific conditions in western Texas.

Analysis of climatic factors indicated that March and April are normally the hazardous months, from the standpoint of high winds and low precipitation. The combination of these two factors in 1952-53 represented the most unfavorable condition experienced in a decade, but the situation was still much more favorable than the extremely adverse combinations of the 1930's.

The erodibility of a field at a given time was governed by conditions at the immediate surface. Surface roughness, amount and type of residue, and cloddiness appear to be the major variables. The relative importance of each of these variables is indicated in a basic formula derived from this study. The formula may be used for estimating the relative erodibility of loose, noncrusted soils, but such estimations would be only approximate. Influences attributive to other factors, such as crusting which is not really measurable with present techniques, are not included in the formula.

Wide contrasts were found in the ability of residue cover to remove the force of the wind from the immediate soil surface. For example, sorghum stubble was capable of taking from 20 to 99 percent of the wind force, depending upon its height and density. Standing stubble was much more effective in protecting the soil than stubble knocked down by tillage, such as one-way disking. In general, the cotton residue on machine-stripped fields was inadequate and afforded poor soil protection.

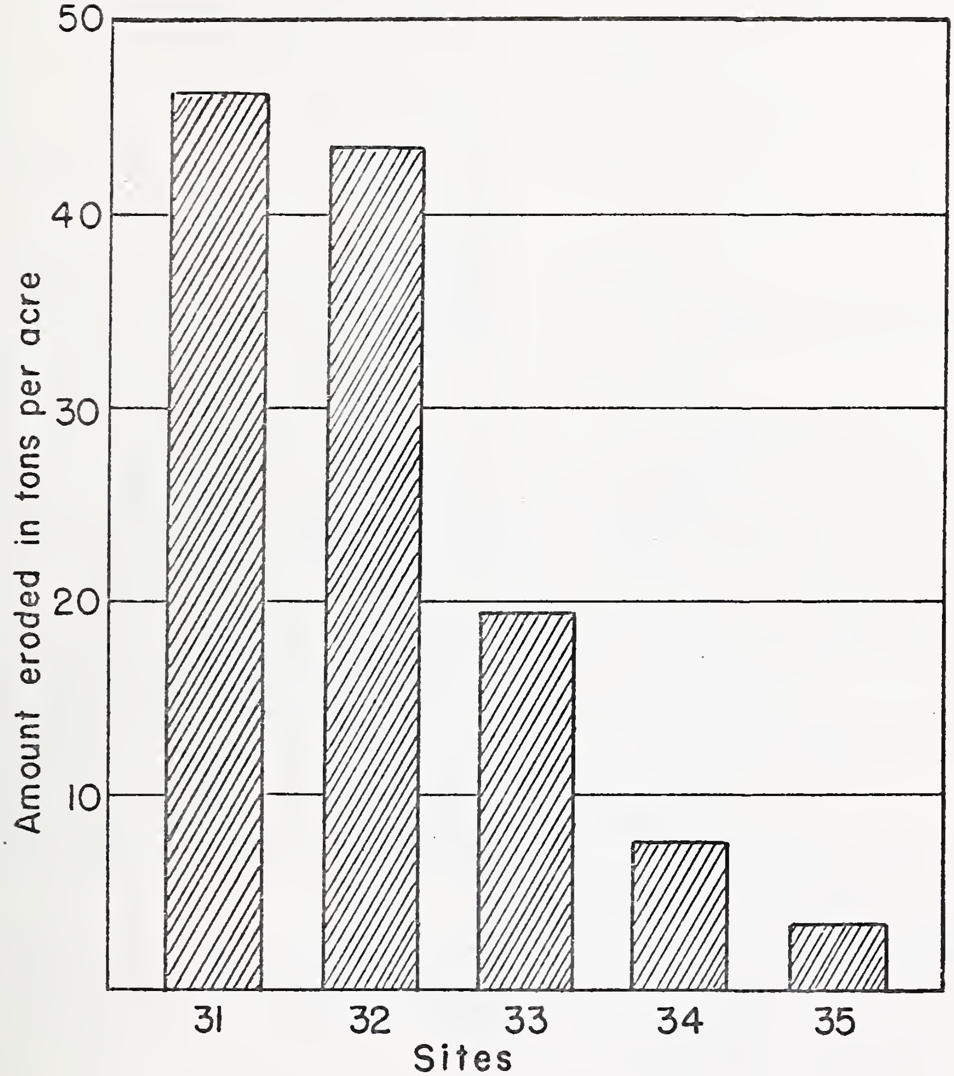


Figure 14.--Amounts of erosion in November 1952 on deep-plowed and not deep-plowed land. Sites 31 and 32 not plowed; Sites 33 and 34 plowed 1950; Site 35 plowed in spring 1952.

Cloddiness and stability of soil material to wind increased with depth in all soils. Soil erodibility was related to cloddiness and to the texture of the soils. On the average, loamy sand was more than 8 times more erodible than sandy loam, and more than 40 times more erodible than the finer textured soils.

The pulverization of soil by mechanical cotton-harvesting equipment appears to be a definite problem from the standpoint of wind-erosion control. Similar effects are produced from trampling by livestock.

Water-stable aggregates of the size resistant to wind are virtually nonexistent in these dryland soils. Resistance to wind action depends primarily on their ability to form clods much larger than the water-stable aggregates. The percentage of clay fractions in these soils governs largely their cloddiness and their ability to resist wind.

The percentage of clay was found to increase with depth in all soils. As a result of wind erosion, silt and clay often are removed from the surface of the soil, and the sand is left behind. This sorting action is extremely hazardous on coarse-textured soils of dryland areas.

Deep tillage was beneficial for wind-erosion control where it brought up compacted clods from lower depths. Stable clods can be brought up periodically as part of a general routine of farming, but the tillage machinery must be of a type that will bury the least amount of crop residue. Listing was extremely useful in controlling erosion by wind, especially on sandy soils having little vegetative cover. The lister buried most of the crop residue, but this was more than compensated for by an increase in soil cloddiness and surface roughness. A chisel was apparently more satisfactory for controlling wind erosion on medium- and fine-textured soils than on coarse-textured soils. Crop residues were more abundant on the former, and a chisel did not bury so much as the lister. More clods were brought to the surface on these soils than on those of coarse texture.

Deep plowing was also beneficial in controlling wind erosion. However, deep-plowed land is not immune to wind erosion; and if erosion is not controlled after plowing, the benefits from this practice are short-lived. More permanent methods must be relied upon if these soils are to be conserved.

As little as 0.3 percent of calcium carbonate in the surface soil of fine sandy loam increased erodibility appreciably. Calcium carbonate appeared to soften the clods and to make them more susceptible to breakdown by mechanical forces.

References

(1) Bouyoucos, G. J.
1951. A recalibration of the hydrometer method for making mechanical analysis of soils. Agron. Jour. 43: 434-438.

(2) Chepil, W. S.
1951. Properties of soil which influence wind erosion: V. mechanical stability of structure. Soil Sci. 72: 465-478.

(3) ________
1952. Improved rotary sieve for measuring state and stability of dry structure. Soil Sci. Soc. Amer. Proc. 16: 113-117.

(4) ________
1953. Factors that influence clod structure and erodibility of soil by wind: I. soil texture. Soil Sci. 75: 473-483.

(5) ________
1953. Factors that influence clod structure and erodibility of soil by wind: II. water-stable structure. Soil Sci. 76: 389-399.

(6) ________
1954. Factors that influence clod structure and erodibility of soil by wind: III. calcium carbonate and decomposed organic matter. Soil Sci. 77: 473-480.

(7) ________
1954. Seasonal fluctuations in soil structure and erodibility of soil by wind. Soil Sci. Soc. Amer. Proc. 18: 13-18.

(8) Englehorn, C. L., Zingg, A. W., and Woodruff, N. P.
1952. The effects of plant residue cover and clod structure on soil losses by wind. Soil Sci. Soc. Amer. Proc. 16: 29-33.

(9) Canada Department of Agriculture
1943. Soil Research Laboratory, Report of investigations, swift current, Sask. Can.

(10) Zingg, A. W.
1950. The intensity-frequency of Kansas winds. U.S. Dept. Agr. Soil Conserv. Serv. Tech. Pub. 88. [Processed.]

(11) ________
1951. Evaluation of the erodibility of field surfaces with a portable wind tunnel. Soil Sci. Soc. Amer. Proc. 15: 11-17.

(12) ______, and Woodruff, N. P.
1951. Calibration of a portable wind tunnel for the simple determination of roughness and drag on field surfaces. Agron. Jour. 43: 191-193.

(13) ______, and Englehorn, C. L.
1952. Effect of wind-row orientation on erodibility of land in sorghum stubble. Agron. Jour. 44: 227-230.

(14) ______, Chepil, W. S., and Woodruff, N. P.
1953. Analysis of wind erosion phenomena in Roosevelt and Curry Counties, New Mexico. Bur. Plant Indus., Soils, Agr. Engin.; Kans. and N. Mex. Agr. Expt. Stas.; Soil Conserv. Serv. M 436. Albuquerque, N. Mex.

TABLE 1.--Conditions of soil structure, surface roughness, crop residue, and soil erodibility of 30 fields tested with portable wind tunnel

Site No.	Soil mapping unit	Capability unit	Crop or treatment	Soil fraction < 0.84 mm.	Ridge roughness equivalent	Crop residue	Amount eroded in tunnel	Estimated erodibility[1] X
				Percent	*Inches*	*Lbs./acre*	*Tons/acre*	
	7-A-2R	II-7	Irrigated milo stubble	59.0	12.5	2,275	0.003	0.006
	7-A-2R	II-7	Irrigated cane stubble	63.9	8.5	1,890	.005	.022
	2-A-1R	II-2	Wheat stubble	52.5	4.4	1,090	.020	.048
	2-A-1R	II-2	Kafir stubble	52.2	5.4	738	.05	.060
	2X-A-1R	II-2X	Irrigated hegari stubble	62.7	4.5	1,010	.06	.115
	7-A-2R	II-7	Cane stubble	67.1	4.3	575	.07	.394
	7-A-2R	II-7	Irrigated cotton, handpicked, with annual lovegrass	79.1	5.6	1,220	.07	.319
	2-A-1R	II-2	Wheat stubble, one wayed	46.0	1.6	425	.14	.458
	7X-A-1R	II-7X	Irrigated cotton, machine stripped, 4 ton/acre gin trash added	77.2	4.1	(2)	.22	(3)
	7-A-2R	II-7	Milo stubble	68.4	6.3	865	.24	.146
	7-A-1R	II-7	Plowed 17 inches deep	34.5	4.0	100	(4)	.374
	2-A-1R	II-2	Wheat just emerged, following wheat	48.3	2.6	790	.36	.112
	2-A-1R	II-2	Irrigated cotton, machine stripped	36.2	5.7	680	.46	.018
	L12-A-2R	IV-L12	Irrigated cotton, machine stripped	79.1	5.0	916	.46	.561
	7-A-1R	II-7	Irrigated cotton, machine stripped	69.9	4.3	1,090	.54	.212
	L12-A-2R	IV-L12	Irrigated sorghum stubble, one wayed	70.4	3.2	3,087	.57	.078
	2-A-1R	II-2	Combine-type kafir	50.1	4.3	605	.71	.089
	7X-A-1R	II-7X	Irrigated cotton, machine stripped	73.3	4.2	430	.72	1.12
	L12-A-2R	IV-L12	Short leafy sorghum planted for cover	86.5	3.1	553	2.50	5.40
	L12-A-2R	IV-L12	Dryland cotton failed, sorghum planted in furrowed land	84.4	5.2	131	3.00	15.48
	7X-A-1R	II-7X	Same as site 18, crust broken by shallow chiseling	70.8	2.7	375	5.33	2.01
	L12-A-2R	IV-L12	Very thin sorghum stubble	88.4	4.3	485	5.74	5.33
	70-A-2R	III-70	Sorghum failed, then sown directly to wheat	82.8	2.5	497	14.0	5.78
	$7X_f$-A-2R	III-$7X_f$	Irrigated cotton, machine stripped	83.5	1.6	401	27.3	15.11
	$7X_f$-A-2R	III-$7X_f$	Sorghum failed, 1-inch sand accumulation	96.3	3.9	238	32.5	84.45
	L12-A-2R	IV-L12	Sorghum failed, 3-inch sand accumulation	99.6	4.2	571	62.5	61.73
	70-A-1L	III-70	Sorghum failed, 3-inch sand accumulation	99.8	3.3	604	[5] 66.3	86.99
	L12-B-2R	IV-L12	Sorghum failed completely on very sandy soil	99.1	1.9	532	152.5	173.8
	70-A-1L	III-70	Wheat on very sandy soil blown badly	94.9	1.4	271	192.5	214.4
	12X-A-2R	VI-12X	Sorghum failed completely on sand	94.7	1.0	312	410.0	271.1

[1] Erodibility was estimated from fig. 9. Erodibility < 0.25 is insignificant, 0.25 to 5.0 is slight to moderate, and > 5.0 is high to very high.
[2] 375 pounds per acre cotton plant residue plus 4 tons per acre gin trash worked into the surface.
[3] Impossible to estimate, because no information could be obtained on the amount of residue present on the surface of the ground.
[4] Unable to set up the dust-catching apparatus because of soft ground.
[5] Surface was damp at the time of test due to foggy weather; otherwise more soil would have eroded.

TABLE 2.--Soil erodibility index 10 I based on dry fractions less than 0.84 mm. determined with the automatic rotary sieve or the hand-rotary sieve

% < 0.84 mm. Units → / Tens ↓	0	1	2	3	4	5	6	7	8	9
0									0.01	0.01
1	0.02	0.02	0.03	0.04	0.04	0.05	0.06	0.07	.08	.09
2	.11	.13	.14	.16	.18	.20	.22	.25	.28	.32
3	.35	.38	.42	.46	.51	.57	.62	.68	.75	.81
4	.88	.96	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7
5	1.8	2.0	2.2	2.4	2.6	2.9	3.1	3.3	3.6	3.8
6	4.2	4.5	4.9	5.3	5.8	6.3	6.7	7.4	8.1	9.0
7	10.	11.	12.	13.	15.	16.	18.	20.	22.	25.
8	29.	32.	36.	40.	45.	51.	57.	65.	75.	86.
9	110.	131.	153.	189.	234.	293.	369.	474.	639.	900.

TABLE 3.--Properties and erodibility of soils at various depths in the fall of 1952.

Site No.	Depth	Mechanical composition: Sand > 0.05 mm.	Silt .05-.002 mm.	Clay < 0.002 mm.	Dry aggregate distribution: > 19.2 mm.	19.2-6.4 mm.	6.4-2.0 mm.	2.0-.84 mm.	.84-.42 mm.	< 0.42 mm.	Mechanical stability of clods	Amount eroded 1/	Water-stable particle distribution: > 0.84 mm.	.84-.42 mm.	.42-.05 mm.	.05-.02 mm.	< 0.02 mm.
	Inches	%	%	%	%	%	%	%	%	%	%	T./A.	%	%	%	%	%
							COARSE TEXTURED										
31	0- 1	87.3	3.6	9.1	1.0	3.9	2.2	1.1	7.1	84.7	27.4	46.1	0.1	2.4	91.9	5.2	0.4
	1- 9	86.5	3.8	9.7	0.5	9.0	5.0	1.9	7.7	75.9	38.4		0.1	2.1	87.2	8.6	2.0
	9-15	61.9	8.6	29.5	64.4	18.9	6.3	2.8	2.0	5.6	96.7		5.0	5.5	76.0	10.5	3.0
32	0- 1	86.0	4.5	9.5	0.4	4.1	2.2	1.0	6.2	86.1	24.3	43.4	0.4	2.6	90.7	4.5	1.8
	1- 9	87.7	5.3	7.0	2.6	10.1	3.9	1.2	6.6	75.6	38.9		0.2	1.8	92.4	4.5	1.1
	9-15	66.2	10.2	23.6	75.8	11.7	3.8	1.8	1.4	5.5	95.8		3.0	3.1	79.9	10.2	3.8
33	0- 1	87.9	1.9	10.2	0.7	6.7	4.0	1.7	3.0	83.9	34.9	19.4	0.1	1.7	92.2	4.5	1.5
	1-17	79.8	4.4	15.8	33.6	17.4	7.9	2.8	2.6	35.7	83.0		0.2	1.8	80.1	12.0	5.9
	17-24	65.7	7.0	27.3	90.4	5.3	1.2	0.6	0.5	2.0	98.0		1.2	3.5	76.8	12.5	6.0
34	0- 1	83.1	3.8	13.1	2.2	10.6	7.2	3.1	3.2	73.7	55.0	7.5	0.1	1.4	88.9	6.0	3.6
	1-14	80.9	2.8	16.3	31.6	10.5	6.3	2.4	2.7	46.5	85.1		0.2	1.6	90.6	6.6	1.0
	14-24	64.3	7.1	28.6	85.1	8.0	2.2	1.1	0.6	3.0	97.3		2.2	4.4	79.5	9.5	4.4
							MEDIUM TEXTURED										
19	0- 1	73.1	11.3	15.6	3.7	10.0	8.3	4.7	3.9	69.4	66.3	5.8	2.2	2.6	78.8	10.0	6.4
	1- 5	72.0	10.8	17.2	39.1	11.0	6.8	3.5	3.2	36.4	86.8		0.8	2.8	77.3	11.5	7.6
	5- 9	72.3	10.4	17.3	48.6	13.5	7.9	4.8	4.1	21.1	86.1		2.3	4.6	75.9	12.0	5.2
21	0- 1	69.6	16.4	14.0	8.6	8.9	7.3	4.4	3.6	67.2	79.5	5.7	0.5	2.4	78.2	8.5	10.4
	1- 5	72.6	11.0	16.4	38.9	12.0	6.9	3.3	2.8	36.1	87.4		0.4	2.2	77.5	15.5	4.4
	5- 9	70.2	10.2	19.6	68.2	10.7	5.3	2.6	1.9	11.3	88.8		1.1	2.8	75.7	12.0	8.4
7	0- 1	65.8	15.4	18.8	1.0	6.7	7.5	5.7	5.3	73.8	63.1	3.6	0.2	2.3	72.3	18.0	7.2
	1- 5	66.5	15.5	18.0	34.1	12.3	7.5	4.4	3.5	38.2	84.2		0.4	2.4	74.8	17.0	5.4
	5- 9	53.4	16.3	30.3	90.3	4.8	1.5	0.8	0.7	1.9	98.7		1.4	5.8	64.8	18.0	10.0
6	0- 1	70.7	11.4	17.9	6.2	12.2	9.2	5.3	5.8	61.3	71.2	3.5	0.3	2.8	76.3	14.6	6.0
	1- 5	69.3	12.4	18.3	31.6	15.7	8.7	4.5	4.5	35.0	86.1		0.2	3.3	76.9	12.0	7.6
	5- 9	61.7	14.8	23.5	80.3	8.3	3.3	2.0	1.4	4.7	97.4		1.8	5.6	72.0	13.5	7.1
35	0- 1	73.7	7.1	19.2	2.2	10.0	10.5	5.6	6.0	65.7	72.9	3.3	0.4	2.8	84.4	8.5	3.9
	1-14	79.6	3.1	17.3	34.5	13.5	6.6	2.5	2.8	40.1	41.8		0.1	2.7	82.6	9.5	5.1
	14-24	64.1	10.1	25.8	82.8	9.8	2.3	1.0	0.9	3.2	97.1		2.0	3.3	76.7	13.2	4.8
15	0- 1	65.2	16.4	18.4	2.5	9.9	10.3	7.4	6.0	63.9	71.5	2.5	0.6	2.4	71.8	15.2	10.0
	1- 6	65.2	13.7	21.1	64.1	8.6	4.7	2.9	2.3	17.4	92.7		1.2	2.9	73.3	18.0	4.6
	6-10	58.2	15.5	26.3	71.6	12.1	4.9	3.3	1.6	6.5	96.4		4.7	4.5	70.5	7.9	12.4
10	0- 1	71.4	11.7	16.9	2.3	13.7	10.0	5.6	5.1	63.3	70.0	2.4	0.2	1.6	78.6	12.0	7.6
	1- 5	69.8	11.6	18.6	69.6	10.4	4.1	2.0	1.5	12.4	79.6		0.3	1.8	75.1	16.0	6.8
	5- 9	59.3	15.3	25.4	91.6	3.8	1.2	0.7	0.4	2.3	96.6		3.0	4.0	73.0	14.5	5.5
2	0- 1	68.9	12.3	18.8	10.8	12.3	7.2	5.8	5.0	58.9	80.2	1.2	0.2	1.7	74.5	16.0	7.6
	1-10	65.3	16.2	18.5	53.4	13.8	6.5	3.1	2.3	20.9	89.0		0.2	2.2	73.2	16.0	8.4
	10-14	51.7	18.8	29.5	80.1	12.2	3.0	1.5	0.8	2.4	97.8		4.2	4.8	65.6	16.6	8.8
9	0- 1	69.6	15.9	14.5	4.9	5.7	6.6	5.6	4.7	72.5	73.2	0.05	0.5	2.4	78.2	8.5	10.4
	1- 5	73.5	10.1	16.4	31.2	10.8	7.0	3.6	3.0	44.4	84.5		0.4	2.2	77.5	15.5	4.4
	5- 9	70.3	10.1	19.6	79.3	9.1	2.4	1.4	1.0	6.8	91.5		1.1	2.8	75.7	12.0	8.4
							FINE TEXTURED										
5	0- 1	50.0	25.5	24.5	2.3	13.2	12.6	9.2	7.7	55.0	75.0	1.3	1.1	4.2	58.9	23.1	12.7
	1- 6	50.5	24.8	24.7	50.6	12.7	7.4	4.6	3.4	21.3	88.0		1.2	4.0	62.4	23.0	9.4
	6-10	48.8	22.2	29.0	75.8	13.1	5.0	2.2	1.0	2.9	98.9		4.3	4.6	61.9	19.6	9.6
1	0- 1	62.3	15.0	22.7	5.4	15.6	12.6	7.4	6.0	53.0	81.0	0.72	0.5	3.0	69.5	17.5	9.5
	1- 5	63.1	15.8	21.1	36.6	12.8	5.1	4.5	4.0	37.0	78.7		0.3	2.9	67.7	21.5	7.6
	5- 9	52.1	17.6	30.3	70.7	12.8	5.7	3.3	1.8	5.7	96.6		3.0	5.1	64.8	20.0	7.1
12	0- 1	39.2	32.2	28.6	12.6	16.6	12.8	9.7	9.6	38.7	87.5	0.55	2.6	6.5	54.3	22.6	14.0
	1- 5	42.1	33.0	24.9	7.2	19.9	16.4	10.5	8.6	37.4	87.0		1.8	5.5	56.7	23.0	13.0
	5- 9	36.5	32.8	30.7	87.3	8.0	2.0	0.8	0.5	1.4	98.5		3.7	8.4	54.5	24.7	8.7
17	0- 1	46.3	28.8	24.9	5.0	20.9	14.5	9.5	8.1	42.0	85.7	0.54	1.6	5.8	65.0	12.0	15.6
	1- 4	41.3	29.9	28.8	33.6	13.9	9.4	6.6	6.1	30.4	93.0		2.4	5.5	55.3	26.0	10.8
	4- 8	42.5	22.8	34.7	90.9	5.1	1.7	0.8	0.4	1.1	98.8		2.9	5.9	45.2	30.0	16.0
13	0- 1	42.3	32.4	25.3	3.6	20.6	21.2	18.4	16.8	19.4	87.5	0.39	3.0	6.3	54.7	21.0	15.0
	1- 5	42.7	30.5	26.8	30.8	18.4	12.3	8.8	6.8	22.9	92.8		2.6	6.4	56.4	23.0	11.6
	5-10	36.7	30.0	33.3	85.4	6.3	2.5	1.6	1.0	3.2	97.4		3.8	6.7	54.7	19.5	15.3
	10-15	37.0	28.9	34.1									8.4	11.0	45.2	20.1	15.3
3	0- 1	36.6	35.4	28.0	6.2	14.6	15.0	11.7	11.9	40.6	84.7	0.36	2.2	9.6	55.7	18.5	14.0
	1- 4	38.5	30.9	30.6	20.4	23.4	14.6	10.0	8.3	23.3	93.5		4.0	8.5	56.3	19.7	11.5
	4- 8	34.9	28.5	36.6	69.7	21.0	5.2	1.8	0.7	1.6	99.1		13.2	14.0	47.6	15.0	10.2
8	0- 1	40.5	30.8	28.7	14.4	18.3	12.1	9.2	8.6	37.4	83.2	0.33	6.6	10.0	53.9	20.0	9.5
	1- 4	37.5	31.0	31.5	43.6	17.7	9.0	6.0	5.0	18.7	94.3		8.1	6.6	52.3	20.6	12.4
	4- 8	39.2	27.7	33.1	34.9	33.3	14.9	5.4	4.9	6.6	99.1		15.3	9.4	47.1	17.0	11.2
4	0- 1	39.4	32.0	28.6	1.3	16.9	17.3	12.3	11.4	40.8	88.9	0.25	4.0	7.1	52.5	24.0	12.4
	1- 4	36.9	34.7	28.4	28.3	19.0	12.8	8.3	6.5	25.1	92.3		4.6	5.6	56.7	20.0	13.1
	4- 8	37.4	29.5	33.1	82.5	10.0	3.2	1.2	0.9	2.2	98.5		9.0	7.5	50.6	18.5	14.4

1/ Amounts eroded from tray samples 5 feet long, 3 inches wide.

TABLE 4.—Properties of soils at various depths in the spring of 1953

Site No.	Depth	Dry aggregate distribution: > 19.0 mm.	19.0–6.4 mm.	6.4–2.0 mm.	2.0–.84 mm.	.84–.42 mm.	< 0.42 mm.	Mechanical stability of clods	Erodibility (10 I)[1]
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Tons/Acre*
COARSE TEXTURED									
31	0-1	6.1	13.8	3.8	1.1	5.5	69.7	34.6	16.4
32	0-1	11.7	14.8	3.3	1.0	4.2	65.0	43.9	9.2
COARSE TEXTURED, DEEP PLOWED									
33	0-1	1.5	9.0	3.6	1.2	4.2	80.5	45.7	49.2
	0-17	37.9	16.0	6.1	2.2	2.9	34.9	83.2	.73
Offset	0-1	8.4	12.4	7.1	3.3	3.7	65.1	70.1	8.8
34	0-1	3.5	11.8	4.8	1.6	3.0	75.3	42.7	22.9
	1-14	9.9	18.8	8.3	3.3	5.0	54.7	67.5	4.1
Offset	0-1	19.3	20.6	9.7	4.0	4.9	41.5	76.6	1.4
35	0-1	5.5	9.9	6.1	2.6	4.6	71.3	65.7	17.8
	1-14	10.6	13.1	5.8	2.2	4.6	63.7	77.6	8.4
MEDIUM TEXTURED									
18	0-1	5.5	11.6	8.2	4.5	4.1	66.1	68.6	10.2
	1-5	11.0	21.3	13.8	6.3	5.7	41.9	72.9	1.6
	5-9	43.2	15.4	11.3	6.5	4.4	19.2	84.1	.17
21	0-1	16.7	13.3	7.9	4.1	3.4	54.6	77.5	3.6
	1-5	17.8	15.9	9.1	4.1	3.2	49.9	78.6	2.4
	5-9	66.5	14.5	6.2	3.0	1.5	8.3	94.1	.02
7	0-1	13.6	24.5	12.3	5.7	4.3	39.6	79.5	1.2
	1-5	8.1	23.2	16.6	9.3	7.7	35.1	73.6	1.1
	5-9	67.9	16.2	7.2	4.2	1.9	2.6	97.9	0
6	0-1	15.8	8.4	7.1	4.5	5.6	58.6	76.3	5.9
	1-5	23.9	17.2	10.5	5.4	5.8	37.2	85.5	1.1
	5-9	79.3	10.5	4.0	2.0	1.3	2.9	98.1	0
15	0-1	27.5	11.1	8.2	5.0	4.6	43.6	82.1	1.6
	1-6	33.4	13.4	10.1	5.3	4.7	33.1	85.6	.73
	6-10	56.8	18.5	7.6	3.7	2.9	10.5	90.4	.04
10	0-1	23.3	9.4	7.3	4.2	4.5	51.3	74.1	3.1
	1-5	33.6	15.2	10.4	5.0	5.0	30.8	87.8	.61
	5-9	73.9	12.1	4.8	2.0	1.3	5.9	95.6	T
2	0-1	10.6	18.3	10.7	5.9	4.9	49.6	69.8	2.8
	1-10	18.7	23.2	12.1	5.9	4.4	35.7	75.3	.89
	10-14	79.5	11.4	3.9	1.8	.9	2.5	97.3	0
FINE TEXTURED									
5	0-1	4.3	16.0	13.0	8.5	7.0	51.2	72.4	3.6
	1-6	58.9	15.5	6.0	2.8	1.8	15.0	87.6	.07
	6-10	76.8	14.0	4.2	1.8	.7	2.5	98.1	0
1	0-1	23.3	14.3	9.9	6.0	5.5	41.0	77.0	1.5
	1-5	16.9	19.7	11.4	6.7	5.9	39.4	78.0	1.3
	5-9	73.3	12.7	5.2	2.8	1.7	4.3	96.6	0
12	0-1	12.5	16.8	11.0	8.5	10.2	41.0	71.0	2.0
	1-5	36.9	17.7	11.4	6.7	5.9	21.4	91.0	.26
	5-9	77.0	16.0	4.3	1.4	.4	.9	97.4	0
17	0-1	14.4	17.3	13.3	8.8	7.6	38.6	85.0	1.4
13	0-1	7.7	18.6	13.6	10.4	10.1	39.6	79.2	1.8
3	0-1	21.7	14.9	11.9	9.2	9.8	32.5	87.4	1.0
8	0-1	18.1	18.6	12.9	9.0	8.7	32.7	86.3	.98
	1-4	20.4	20.9	14.8	9.8	7.7	26.4	92.6	.52
	4-8	69.2	19.9	6.1	2.5	.8	1.5	98.0	0
4	0-1	28.4	20.1	13.9	9.1	6.8	21.7	68.0	.30

[1] Erodibility based on 10I values of table 2.

TABLE 5.—Properties of soils at various depths in fields near Brownfield, Tex., in fall, 1953

Site No.	Soil type, unit, and treatment	Depth	$CaCO_3$	Mechanical composition: Sand > 0.05 mm.	Mechanical composition: Silt 0.05–0.002 mm.	Mechanical composition: Clay < 0.002 mm.	Dry aggregates: > 6.4 mm.	Dry aggregates: 6.4–0.84 mm.	Dry aggregates: < 0.84 mm.	Erodi-tility[1] 10 I
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Tons/Acre*
14.	Amarillo loamy fine sand,	0- 1	0.06	76.4	11.4	12.2	23.4	14.2	62.4	5.1
	L12-A-2R	1-20	.03	85.4	4.4	10.2	42.8	11.7	45.5	1.3
	(Plowed 22", irrigated)	20-26	.08	66.4	11.9	21.7	85.7	10.5	3.8	T
16.	Amarillo loamy fine sand,	0- 1	.06	85.4	6.1	8.5	5.7	10.2	84.1	45.1
	L12-A-2R	1-22	.01	75.2	9.0	15.8	42.7	13.3	44.0	1.2
	(Plowed 22", irrigated)	22-28	.10	63.8	15.9	20.3	89.3	7.1	3.6	T
26.	Amarillo loamy fine sand,	0- 1	.04	90.9	3.4	5.7	3.2	1.8	95.0	293.0
	L12-A-2R	1-12	.06	87.3	5.7	7.0	21.9	14.8	63.3	5.5
	(Not plowed; dry farmed)	12-18	.07	63.1	12.9	24.0	71.1	19.7	9.2	.01
24.	Drake fine sandy loam,	0- 1	3.10	82.6	8.9	8.5	3.8	3.2	93.0	189.0
	7X$_c$-A-2R	1- 5	3.24	84.3	7.2	8.5	10.6	4.2	85.2	52.0
	(Irrigated cotton, not plowed)	5- 9	8.22	58.3	21.7	20.0	76.3	11.9	11.8	.03
25.	Drake fine sandy loam,	0- 1	5.78	77.6	11.9	10.5	9.7	8.6	81.7	35.0
	7X$_c$-A-2R	1-12	4.60	78.0	10.5	11.5	42.8	10.8	46.4	1.4
	(Dryland sorghum failed)	12-16	8.25	57.1	17.8	25.1	69.3	15.6	15.1	.05
36.	Amarillo fine sandy loam,	0- 1	.03	74.3	13.2	12.5	17.4	13.6	69.0	9.0
	7-A-1R	1- 6	.01	73.2	12.5	14.3	49.6	16.8	33.6	.49
	(Dryland sorghum failed)	6-12	.07	69.0	9.7	21.3	78.8	12.0	9.2	.01
37.	Amarillo fine sandy loam,	0- 1	.05	79.1	9.3	11.6	12.5	12.3	75.2	16.5
	7-A-1R	1- 7	.05	72.7	12.9	14.4	64.3	12.9	22.8	.16
	(Sorghum stubble)	7-12	.01	62.4	14.0	23.6	75.6	17.2	7.2	.01
38.	Portales fine sandy loam,	0- 1	.33	70.6	14.0	15.4	15.2	14.5	70.3	10.0
	7X-A-1R	1- 6	.26	63.1	18.7	18.2	24.7	20.7	54.6	2.9
	(Sorghum failed)	6-10	2.42	57.0	20.3	22.7	77.0	13.7	9.3	.01
39.	Portales fine sandy loam,	0- 1	.66	64.0	18.6	17.4	20.2	17.7	62.1	4.9
	7X-A-1R	1- 6	.66	61.4	20.5	18.1	18.2	23.4	58.4	3.6
	(Sorghum failed, listed 10")	6-10	3.82	56.1	19.7	24.2	82.5	9.9	7.6	.01
40.	Portales loam	0- 1	.48	68.8	15.4	15.8	43.9	16.8	39.3	.81
	2X-A-1R	1- 6	.80	69.6	13.8	16.6	45.0	14.6	40.4	.90
	(Sorghum failed listed deeper than site 39)	6-10	2.23	59.6	18.5	21.9	80.2	11.6	8.2	.01

[1] Erodibility based on 10 I values of table 2.

TABLE 6.—Data pertaining to supplementary sites selected for study of the influence of soil properties on erodibility by wind.

Site No.	Date Sampled	Soil type	Mapping Unit	Farm	Location	Crop and treatment
31.	Nov. 1952	Amarillo loamy fine sand	L12-A-2R	Terry County Experiment Station	S 1/2 Sec. 94, Blk D 11	Milo, not deep plowed.
32.	Nov. 1952	Amarillo loamy fine sand	L12-A-2R	Terry County Experiment Station	S 1/2 Sec. 94, Blk D 11	Cotton, not deep plowed.
33.	Nov. 1952	Amarillo loamy fine sand	L12-A-2R	Terry County Experiment Station	S 1/2 Sec. 94, Blk D 11	Milo, plowed 17 inches in 1950.
34.	Nov. 1952	Amarillo loamy fine sand	L12-A-2R	Terry County Experiment Station	S 1/2 Sec. 94, Blk D 11	Milo, plowed 14 inches in 1950.
35.	Nov. 1952	Amarillo loamy fine sand	L12-A-2R	Terry County Experiment Station	S 1/2 Sec. 94, Blk D 11	Cotton, plowed 14 inches in 1952.
36.	Dec. 1953	Amarillo fine sandy loam	7-A-1R	Lawrence	SW 1/4 Sec. 1, Blk A 1	Sorghum failed.
37.	Dec. 1953	Amarillo fine sandy loam	7-A-1R	Lawrence	NW 1/4 Sec. 1, Blk A 1	Sorghum stubble.
38.	Dec. 1953	Portales fine sandy loam	7X-A-1R	Early	SW 1/4 Sec. 100	Sorghum failed.
39.	Dec. 1953	Portales fine sandy loam	7X-A-1R	Early	200 feet north of site 38	Sorghum failed, listed 10 inches.
40.	Dec. 1953	Portales loam	2X-A-1R	Early	NW 1/4 Sec. 410	Same as site 39 but listed deeper

TABLE 7.—Relation of free calcium carbonate (lime) to soil structure and erodibility. (Averages of fall and spring samples for sites 10, 15, 18, and 21.)

Site no.	Soil type	Depth	$CaCO_3$	Clay: Actual	Clay: As on site 18 or 25	Erodible fraction < 0.84 mm.[1]	Mechanical stability of clods	Erodibility 10 I
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Tons/Acre*
0	Amarillo fine sandy loam	0-1	0.23	16.9	15.6	59.3	72.0	4.2
		1-5	.23	18.6	17.2	22.8	83.7	.16
		5-9	.32	25.4	17.3	7.3	96.1	T
5	Amarillo fine sandy loam	0-1	.13	18.4	15.6	52.9	76.8	1.7
		1-6	.11	21.1	17.2	24.9	89.2	.17
		6-10	.13	26.3	17.3	7.8	93.4	.01
8	Mansker fine sandy loam	0-1	.73	15.6	15.6	71.8	67.4	11.8
		1-5	1.52	17.2	17.2	43.6	79.4	1.16
		5-9	3.64	17.3	17.3	24.4	85.1	.19
1	Mansker fine sandy loam	0-1	.32	14.0	15.6	67.0	78.5	11.6
		1-5	.73	16.4	17.2	45.6	83.0	1.5
		5-9	1.59	19.6	17.3	10.4	91.4	.02
14	Drake fine sandy loam	0-1	3.10	8.5	10.5	90.0	—	110.0
		1-5	3.24	8.5	11.5	79.5	—	27.0
		5-9	8.22	20.0	25.1	9.7	—	.02
15	Drake fine sandy loam	0-1	5.78	10.5	10.5	81.7	—	35.0
		1-12	4.60	11.5	11.5	46.4	—	1.45
		12-16	8.25	25.1	25.1	15.1	—	.05
16	Amarillo fine sandy loam	0-1	.03	12.5	10.5	75.7	—	16.7
		1-6	.007	14.3	11.5	36.2	—	.63
		6-12	.074	21.3	25.1	7.9	—	.01
17	Amarillo fine sandy loam	0-1	.055	11.6	10.5	76.1	—	18.0
		1-7	.055	14.4	11.5	24.9	—	.19
		7-12	.01	23.6	25.1	6.7	—	.01

[1] Adjusted on the basis of percent clay equal to that on site 18 and 25, respectively. Adjustment was made in accordance with the relationship shown in figure 11.

TABLE 8.—Effects of seasons on soil structure and residue cover

Soil type and site No.	Depth	Erodible fraction < 0.84 mm.: Fall	Erodible fraction < 0.84 mm.: Spring	Mechanical stability of clods: Fall	Mechanical stability of clods: Spring	Crop residue: Fall	Crop residue: Spring
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Lbs./acre*	*Lbs./acre*
Pullman clay loam (site 12)	0-1	48.3	51.2	87.5	71.0	790	1,200
	1-5	46.0	27.3	87.0	91.0	—	—
	5-9	1.9	1.3	98.5	97.4	—	—
Rita sandy clay loam (site 5)	0-1	62.7	58.2	75.0	72.4	1,010	950
	1-6	24.7	16.8	88.0	87.6	—	—
	6-10	3.9	3.2	98.9	98.1	—	—

TABLE 9.—Average influence of listing and chiseling on soil structure, crop residue, surface roughness, and erodibility

COARSE-TEXTURED SOILS

Site No.	Time and treatment	Erodible fraction < 0.84 mm.	Crop residue	Ridge roughness equivalent	Erodibility index X
		Percent	*Lbs./acre*	*Inches*	
0	Before chiseling	86.9	1,485	7.1	0.44
0	After chiseling	84.7	500	3.0	5.30
1, 32	Before listing	83.2	872	4.9	1.00
4, 35	After listing	74.7	212	10.0	1.03

MEDIUM-TEXTURED SOILS

Site No.	Time and treatment	Erodible fraction < 0.84 mm.	Crop residue	Ridge roughness equivalent	Erodibility index X
6, 10	Before chiseling	68.5	843	5.0	0.21
15	After chiseling	56.1	450	5.5	.17
2, 7	Before listing	71.8	979	5.2	.23
18, 21	After listing	56.6	150	9.9	.35

FINE-TEXTURED SOILS

Site No.	Time and treatment	Erodible fraction < 0.84 mm.	Crop residue	Ridge roughness equivalent	Erodibility index X
3, 8	Before chiseling	46.2	700	4.0	0.06
13, 17	After chiseling	44.9	325	3.8	.18
, 4	Before listing	55.6	1,506	9.0	.014
, 4	After listing	37.5	225	10.0	.043

SITE 1

Whittaker Farm (NE 1/4 Sec. 33, Blk. JS), Lubbock County, Tex.

Soil Unit: 7-A-2R   Capability Unit: II-7   Soil Type: Amarillo fine sandy loam

November 6, 1952. Irrigated milo combined for grain, leaving stubble 16 to 18 inches high. Estimated yield is 1,000 pounds of grain per acre. Soil is heavily crusted. Some regrowth of milo and annual weed growth is present in middles. Average spacing of sorghum is 3.2 inches. Surface cover is excellent.

Surface Conditions:

Mechanical composition	62.3 percent sand,	15.0 percent silt,	22.7	percent clay
Residue *R*			2,275	lbs./acre
Ridge roughness equivalent *K*			12.5	inches
Velocity reduction at 1-inch height due to cover			90.0	percent
Force taken by cover above 1-inch height			99.0	percent
Soil fraction less than 0.84 mm.			59.0	percent
Soil eroded in tunnel			0.003	ton/acre

SITE 2

McMenamy Farm (E 1/2 Sec. 30, Blk. JS), Lubbock County, Tex.

Soil Unit: 7-A-2R   Capability Unit: II-7   Soil Type: Amarillo fine sandy loam

November 6, 1952. Cane cut with row binder, leaving 8- to 10-inch stubble. Average spacing of plants in row is 2.1 inches. Field has been irrigated and a substantial regrowth has occurred since harvest. Deep-water furrow between rows, with surface heavily crusted. Field has been cultivated for 20- to 25-year period. Surface protection is excellent.

Surface Conditions:

Mechanical composition	68.9 percent sand,	12.3 percent silt,	18.8	percent clay
Residue *R*			1,890	lbs./acre
Ridge roughness equivalent *K*			8.5	inches
Velocity reduction at 1-inch height due to cover			67.0	percent
Force taken by cover above 1-inch height			89.0	percent
Soil fraction less than 0.84 mm.			63.9	percent
Soil eroded in tunnel			0.005	ton/acre

SITE 3

Buchanan Bros. Farm (NE 1/4 Sec. 26, Blk. R), Hale County, Tex.

Soil Unit: 2-A-1R Capability Unit: II-2 Soil Type: Pullman silty clay loam

November 6, 1952. Wheat stubble from 1952 harvest, managed in a delayed fallow system. Stubble after combining is 8 to 10 inches high. The field has been grazed lightly. Surface is slightly crusted but much of crust has been broken by trampling. Well protected against wind.

Surface Conditions:

Mechanical composition	36.6 percent sand,	35.4 percent silt,	28.0 percent clay
Residue *R*			1,090 lbs./acre
Ridge roughness equivalent *K*			4.4 inches
Velocity reduction at 1-inch height due to cover			36.0 percent
Force taken by cover above 1-inch height			59.0 percent
Soil fraction less than 0.84 mm.			52.5 percent
Soil eroded in tunnel			0.02 ton/acre

SITE 4

Buchanan Bros. Farm (SE 1/4 Sec. 21, Blk. D7), Hale County, Tex.

Soil Unit: 2-A-1R   Capability Unit: II-2   Soil Type: Pullman silty clay loam

November 6, 1952. 1952 kafir crop cut with a row binder. The crop has been drilled in 40-inch rows. Average spacing of plants in the row is 7.6 inches. Height of the stubble is 6 to 8 inches. Yield for the crop was very light. Cover is fair, but soil is quite resistant to wind erosion.

Surface Conditions:

Mechanical composition	39.4 percent sand,	32.0 percent silt,	28.6	percent clay
Residue *R*			738	lbs./acre
Ridge roughness equivalent *K*			5.4	inches
Velocity reduction at 1-inch height due to cover			14.0	percent
Force taken by cover above 1-inch height			26.0	percent
Soil fraction less than 0.84 mm.			52.2	percent
Soil eroded in tunnel			0.05	ton/acre

SITE 5

Mowery Farm (NW 1/4 Sec. 33, Blk. JS), Lubbock County, Tex.

Soil Unit: 2X-A-1R   Capability Unit: II-2X   Soil Type: Zita sandy clay loam

November 6, 1952. Field of irrigated hegari planted in 12-inch rows. Stand is heavy, with average plant spacing of 3.2 inches. Material has been cut with grain binder, leaving stubble 6 to 7 inches high. Soil has hard crust and harvesting equipment has not marked the surface. Surface cover is good.

Surface Conditions:

Mechanical composition	50.0 percent sand,	25.5 percent silt,	24.5 percent clay
Residue R			1,010 lbs./acre
Ridge roughness equivalent K			4.5 inches
Velocity reduction at 1-inch height due to cover			30.0 percent
Force taken by cover above 1-inch height			51.0 percent
Soil fraction less than 0.84 mm.			62.7 percent
Soil eroded in tunnel			0.061 ton/acre

SITE 6

Texas Tech Farm (NE 1/4 Sec. 2, Blk. E2), Lubbock County, Tex.

Soil Unit: 7-A-2R Capability Unit: II-7 Soil Type: Amarillo fine sandy loam

November 6, 1952. Cane stubble. Crop drilled in 40-inch rows, with average spacing of 3.2 inches in row. Crop attained height of 3 feet but did not mature. Cut with row binder leaving 5- to 7-inch stubble. Cultivation has ridged surface considerably. Surface of soil is slightly crusted but crust is broken between ridges by harvesting equipment. Sorghum following sorghum. The field has been in cultivation for a 30-year period. Cover is fair, but the soil is quite resistant to wind erosion.

Surface Conditions:

Mechanical composition	70.7 percent sand,	11.4 percent silt,	17.9 percent clay
Residue R			575 lbs./acre
Ridge roughness equivalent K			4.3 inches
Velocity reduction at 1-inch height due to cover			25.0 percent
Force taken by cover above 1-inch height			44.0 percent
Soil fraction less than 0.84 mm.			67.1 percent
Soil eroded in tunnel			0.07 ton/acre

SITE 7

Gruetzner Farm (SE 1/4 Sec. 35, Blk. JS), Lubbock County, Tex.

Soil Unit: 7-A-2R Capability Unit: II-7 Soil Type: Amarillo fine sandy loam

November 6, 1952. Hand-picked irrigated cotton. Yield approximately 3/4 bale per acre. Plants 16 to 18 inches in height. Rows have 40-inch spacing, with average intervals of 4.1 inches between plants. Fair cover of annual lovegrass obtained by eliminating last cultivation. Some water furrow erosion, leaving erodible sand exposed in middles. The soil is quite erodible, but is for the present well protected by the cover.

Surface Conditions:

Mechanical composition	65.8 percent sand,	15.4 percent silt,	18.8	percent clay
Residue *R*			1,220	lbs./acre
Ridge roughness equivalent *K*			5.6	inches
Velocity reduction at 1-inch height due to cover			57.0	percent
Force taken by cover above 1-inch height			82.0	percent
Soil fraction less than 0.84 mm.			79.1	percent
Soil eroded in tunnel			0.07	ton/acre

SITE 8

Buchanan Bros. Farm (SW 1/4 Sec. 22, Blk. D7), Hale County, Tex.

Soil Unit: 2-A-1R Capability Unit: II-2 Soil Type: Pullman silty clay loam

November 6, 1952. Wheat stubble one-wayed after harvest of 1952 crop. Wheat yield was 5 to 6 bushels per acre. Residue is partially buried from tillage operations, and field presents a relatively smooth surface. No volunteer wheat and very little growth of weed grasses are present. The soil surface is crusted slightly. This land is well protected from wind.

Surface Conditions:

Mechanical composition	40.5 percent sand,	30.8 percent silt,	28.7 percent clay
Residue *R*			425 lbs./acre
Ridge roughness equivalent *K*			1.6 inches
Velocity reduction at 1-inch height due to cover			4.0 percent
Force taken by cover above 1-inch height			8.0 percent
Soil fraction less than 0.84 mm.			46.0 percent
Soil eroded in tunnel			0.14 ton/acre

SITE 9

Texas Tech Farm (SE 1/4 Sec. 21, Blk. A), Lubbock County, Tex.

Soil Unit: 7X-A-1R Capability Unit: II-7X Soil Type: Portales fine sandy loam

November 6, 1952. Machine-stripped storm-proof cotton. (Same as site 18.) Four tons per acre of gin trash were spread on surface and the chisel used to partially cover and anchor trash. The land is fairly well protected against wind.

Surface Conditions:

Mechanical composition	69.6 percent sand,	15.9 percent silt	14.5	percent cla
Residue *R*			*	lbs.
Ridge roughness equivalent *K*			4.1	i
Velocity reduction at 1-inch height due to cover			18.0	perce
Force taken by cover above 1-inch height			33.0	percen
Soil fraction less than 0.84 mm.			77.2	percent
Soil eroded in tunnel			0.22	ton/acre

*375 lbs./acre cotton plant residue plus 4 tons/acre gin trash.

SITE 10

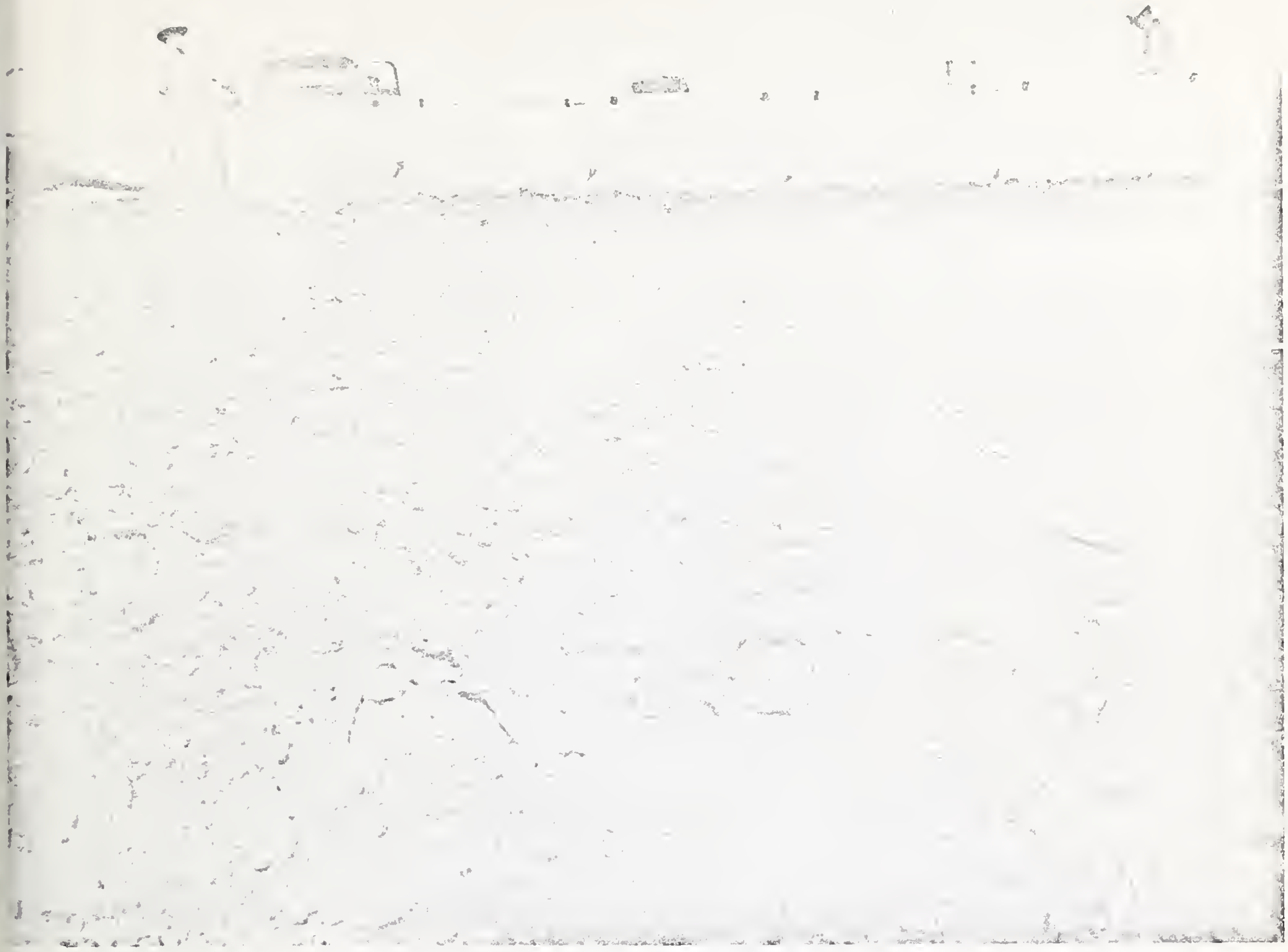
Texas Tech Farm (NW 1/4 Sec. 1, Blk. E2), Lubbock County, Tex.

Soil Unit: 7-A-2R   Capability Unit: II-7   Soil Type: Amarillo fine sandy loam

November 6, 1952. Milo combined for grain, leaving 10- to 12-inch stubble. Row spacing is 40 inches, with plants averaging 8-inch spacing in row. Yield was approximately 500 pounds of grain per acre. Surface is somewhat ridged from cultivation and slightly crusted. The field has been in cultivation for a 30-year period. It is reasonably well protected against wind.

Surface Conditions:

Mechanical composition	71.4 percent sand,	11.7 percent silt,	16.9 percent clay
Residue *R*			865 lbs./acre
Ridge roughness equivalent *K*			6.3 inches
Velocity reduction at 1-inch height due to cover			36.0 percent
Force taken by cover above 1-inch height			59.0 percent
Soil fraction less than 0.84 mm.			68.4 percent
Soil eroded in tunnel			0.24 ton/acre



SITE 11

Farrar Farm (NE 1/4 Sec. 146, Blk. T), Terry County, Tex.

Soil Unit: 7-A-1R   Capability Unit: II-7   Soil Type: Zita fine sandy loam

January 27, 1954. Land plowed with a disk plow 16 to 18 inches deep to bring some clay to the surface. Clods at present resist wind quite well. The ground was too soft to drive over and measurement of the amount of eroded soil was not made. The field is slightly susceptible to wind erosion.

Surface Conditions:

Mechanical composition	59.6 percent sand,	26.6 percent silt,	13.8 percent clay
Residue *R*			100 lbs./acre
Ridge roughness equivalent *K*			4.0 inches
Velocity reduction at 1-inch height due to cover			--- percent
Force taken by cover above 1-inch height			--- percent
Soil fraction less than 0.84 mm.			34.5 percent
Soil eroded in tunnel			Not measured tons/acre

SITE 12

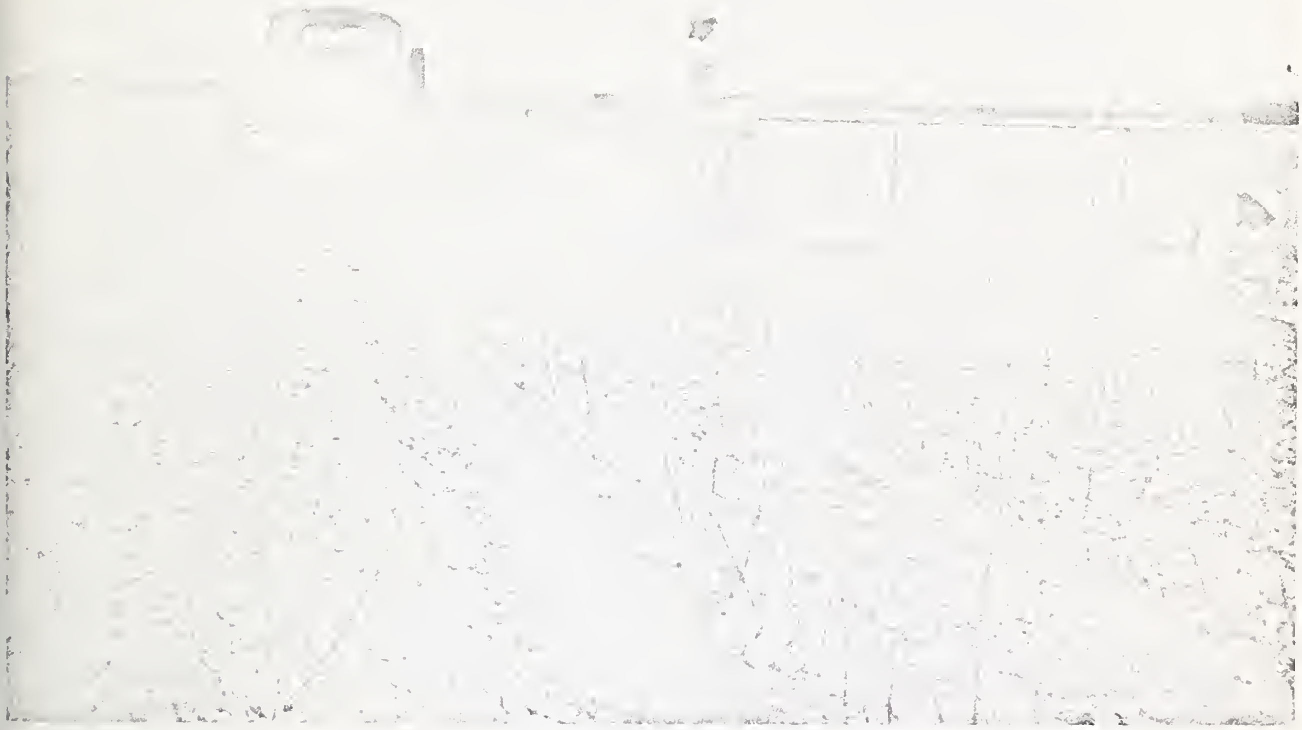
Buchanan Bros. Farm (SE 1/4 Sec. 21, Blk. D7), Hale County, Tex.

Soil Unit: 2-A-1R   Capability Unit: II-2   Soil Type: Pullman silty clay loam

November 6, 1952. Wheat after wheat. One-wayed two times after harvest and drilled with semideep furrow drill in 12-inch rows. Wheat stand appears good, but some is dying due to drought. Stubble from 1952 wheat crop is well mixed into topsoil. The soil surface is dry and loose, with little or no surface crust. This field has inadequate cover, but a considerable proportion of small clods resist wind appreciably at the present time.

Surface Conditions:

Mechanical composition	39.2 percent sand,	32.2 percent silt,	28.6 percent clay
Residue *R*			790 lbs./acre
Ridge roughness equivalent *K*			2.6 inches
Velocity reduction at 1-inch height due to cover			9.0 percent
Force taken by cover above 1-inch height			17.0 percent
Soil fraction less than 0.84 mm.			48.3 percent
Soil eroded in tunnel			0.36 ton/acre



SITE 13

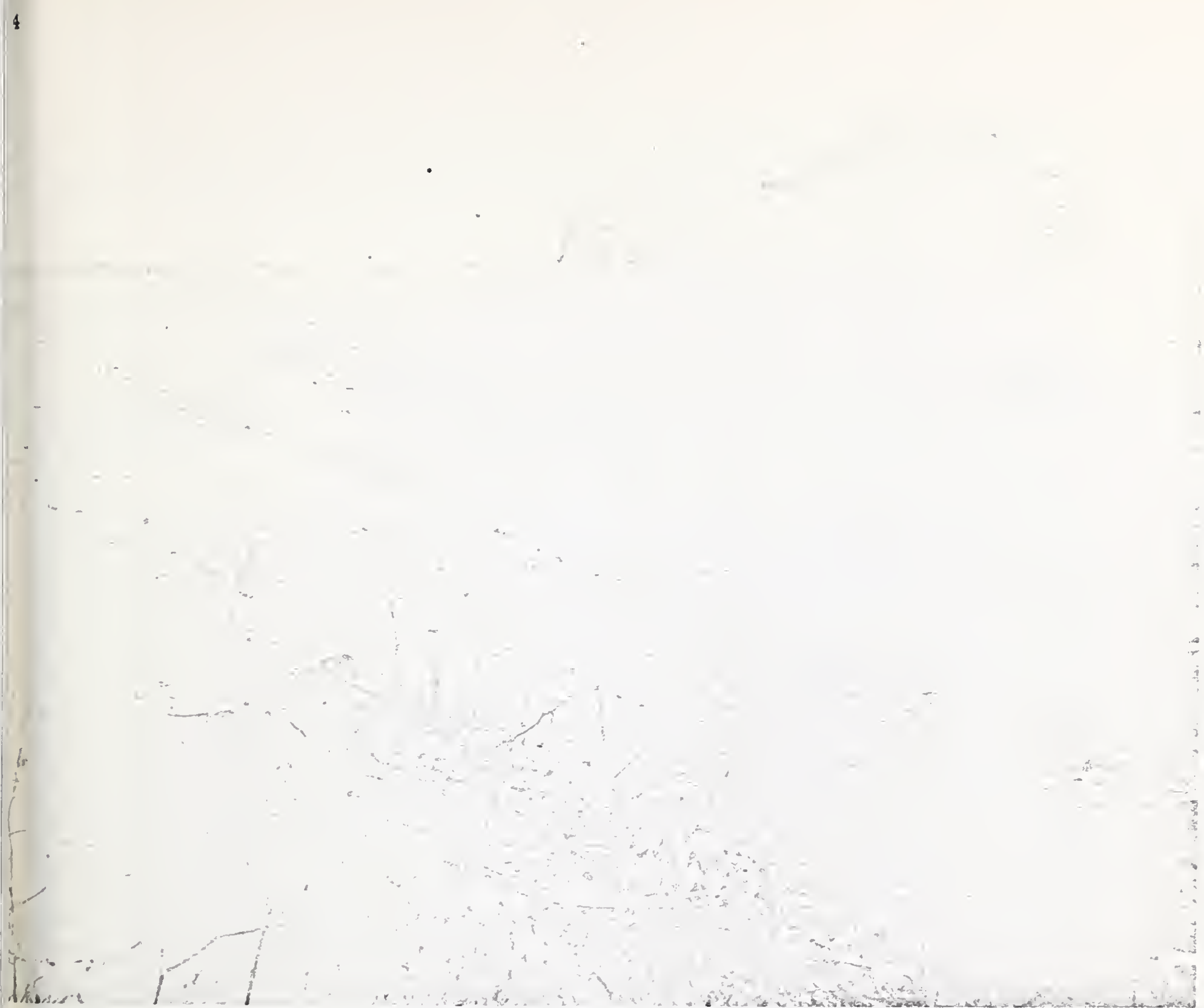
Budd Farm (NW 1/4 Sec. 22, Blk. D7), Hale County, Tex.

Soil Unit: 2-A-1R   Capability Unit: II-2   Soil Type: Pullman silty clay loam

November 6, 1952. Machine-stripped cotton. Crop grown under furrow irrigation system in 40-inch rows. Plants 18 to 20 inches high, with spacing within row of 5 inches. Heavy surface crust, about 40 percent of which has been broken by harvesting equipment. The soil has poor protection, but out of the total of 30 fields this soil is next to the least erodible.

Surface Conditions:

Mechanical composition	42.3 percent sand,	32.4 percent silt,	25.3 percent clay
Residue *R*			680 lbs./acre
Ridge roughness equivalent *K*			5.7 inches
Velocity reduction at 1-inch height due to cover			19.0 percent
Force taken by cover above 1-inch height			34.0 percent
Soil fraction less than 0.84 mm.			36.2 percent
Soil eroded in tunnel			0.46 ton/acre



SITE 14

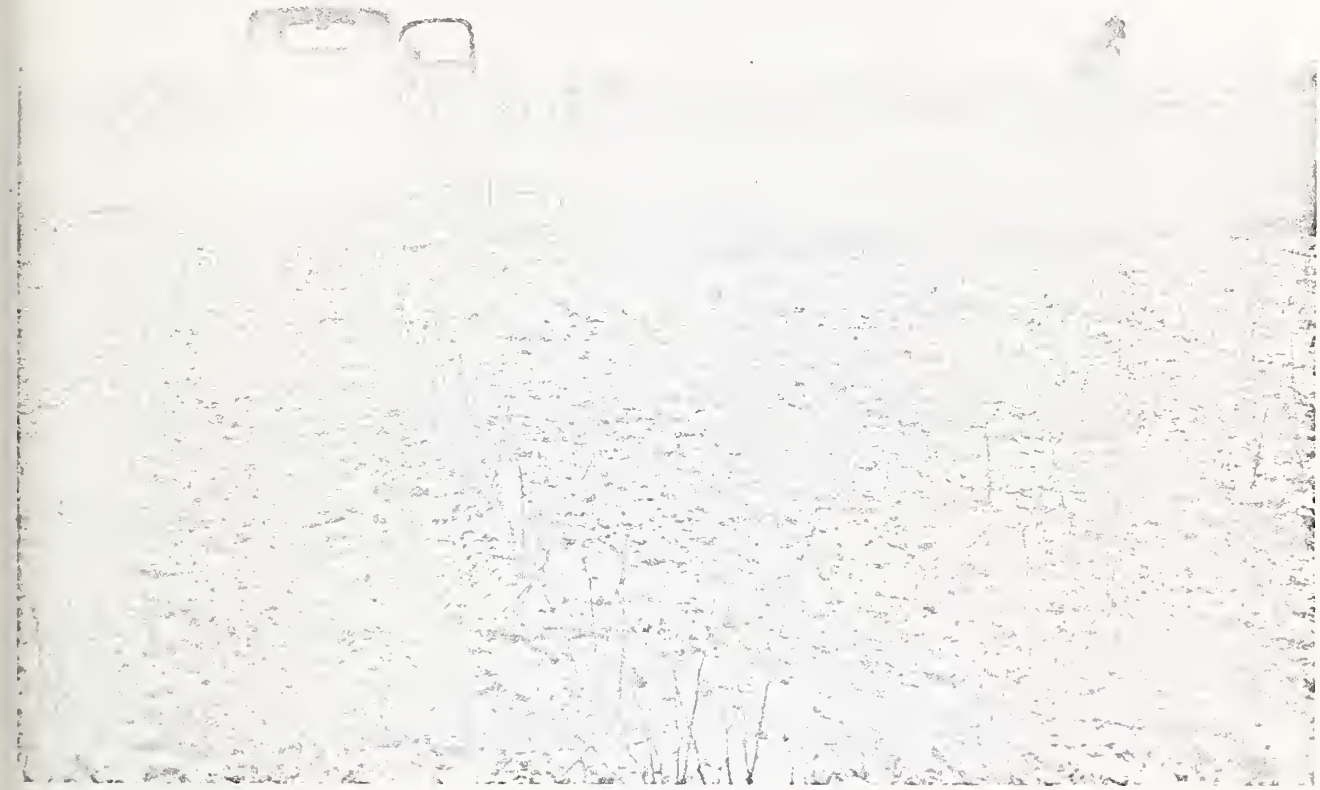
Purtell Farm (NE 1/4 Sec. 149, Blk. T), Terry County, Tex.

Soil Unit: L12-A-2R Capability Unit: IV-L12 Soil Type: Amarillo loamy fine sand.

January 26, 1954. Machine-stripped cotton on irrigated land, plowed 22 inches deep in 1952. Yield about 3/4 bale per acre. Planted in 40-inch rows, with average spacing about 3 inches between plants in row. Stalks 12 to 14 inches high. Soil was slightly crusted. About 70 percent of the crust is broken by the stripping operation. No natural erosion is apparent after high winds. This field is rated slightly susceptible to wind erosion.

Surface Conditions:

Mechanical composition	78.9 percent sand,	10.2 percent silt,	10.9	percent clay
Residue *R*			916	lbs./acre
Ridge roughness equivalent *K*			5.0	inches
Velocity reduction at 1-inch height due to cover			46.8	percent
Force taken by cover above 1-inch height			72.7	percent
Soil fraction less than 0.84 mm.			79.1	percent
Soil eroded in tunnel			0.46	ton/acre



SITE 15

Texas Tech Farm (SE 1/4 Sec. 21, Blk. A), Lubbock County, Tex.

Soil Unit: 7-A-1R Capability Unit: II-7 Soil Type: Amarillo fine sandy loam

November 6, 1952. Storm-proof cotton that has received a preplanting irrigation. Machine-stripped, with estimated yield of 1 bale per acre. Cotton planted in 40-inch rows, with average spacing of 4.3 inches in row. Average height, 10 to 14 inches. Slight surface crust, about 40 percent of which has been broken by harvesting machinery. This field has been in cultivation since 1947. The field is moderately susceptible to wind erosion.

Surface Conditions:

Mechanical composition	65.2 percent sand,	16.4 percent silt,	18.4	percent clay
Residue *R*			1,090	lbs./acre
Ridge roughness equivalent *K*			4.3	inches
Velocity reduction at 1-inch height due to cover			22.0	percent
Force taken by cover above 1-inch height			39.0	percent
Soil fraction less than 0.84 mm.			69.9	percent
Soil eroded in tunnel			0.54	ton/acre

SITE 16

·9, Blk. T), Terry County, Tex.

..ility Unit: IV-L12 Soil Type: Amarillo loamy fine sand

..ubble on irrigated land, one-way disked once. Yield of grain was 3,000 ..s plowed 22 inches deep in 1952. The soil is loose and erodible but is ..sidue. No appreciable erosion occurred after January 1954 high winds. ..d slight to moderate. If this field had not been one-wayed, it would have ..n erosion, like sites 1 and 2. The farmer did this to prevent accumu- ..ghboring dryland field.

76.8 percent sand,	12.2 percent silt,	11.0 percent clay
		3,087 lbs./acre
K		3.2 inches
height due to cover		9.6 percent
1-inch height		18.4 percent
mm.		70.4 percent
		0.57 ton/acre

SITE 17

Buchanan Bros. Farm (NW 1/4 Sec. 26, Blk. R), Hale County, Tex.

Soil Unit: 2-A-1R   Capability Unit: II-2   Soil Type: Pullman silty clay loam

November 6, 1952. Combine type kafir. Crop did not mature, and grain and leafy material is being grazed out. Crop drilled in 40-inch rows. Average spacing of plants in the row is 15.8 inches. The stubble ranges in height from 0 to 24 inches. Trampling by livestock has tended to level and pulverize the surface. The field is moderately susceptible to wind erosion.

Surface Conditions:

Mechanical composition	46.3 percent sand,	28.8 percent silt,	24.9 percent clay
Residue *R*			605 lbs./acre
Ridge roughness equivalent *K*			4.3 inches
Velocity reduction at 1-inch height due to cover			11.0 percent
Force taken by cover above 1-inch height			21.0 percent
Soil fraction less than 0.84 mm.			50.1 percent
Soil eroded in tunnel			0.71 ton/acre

SITE 18

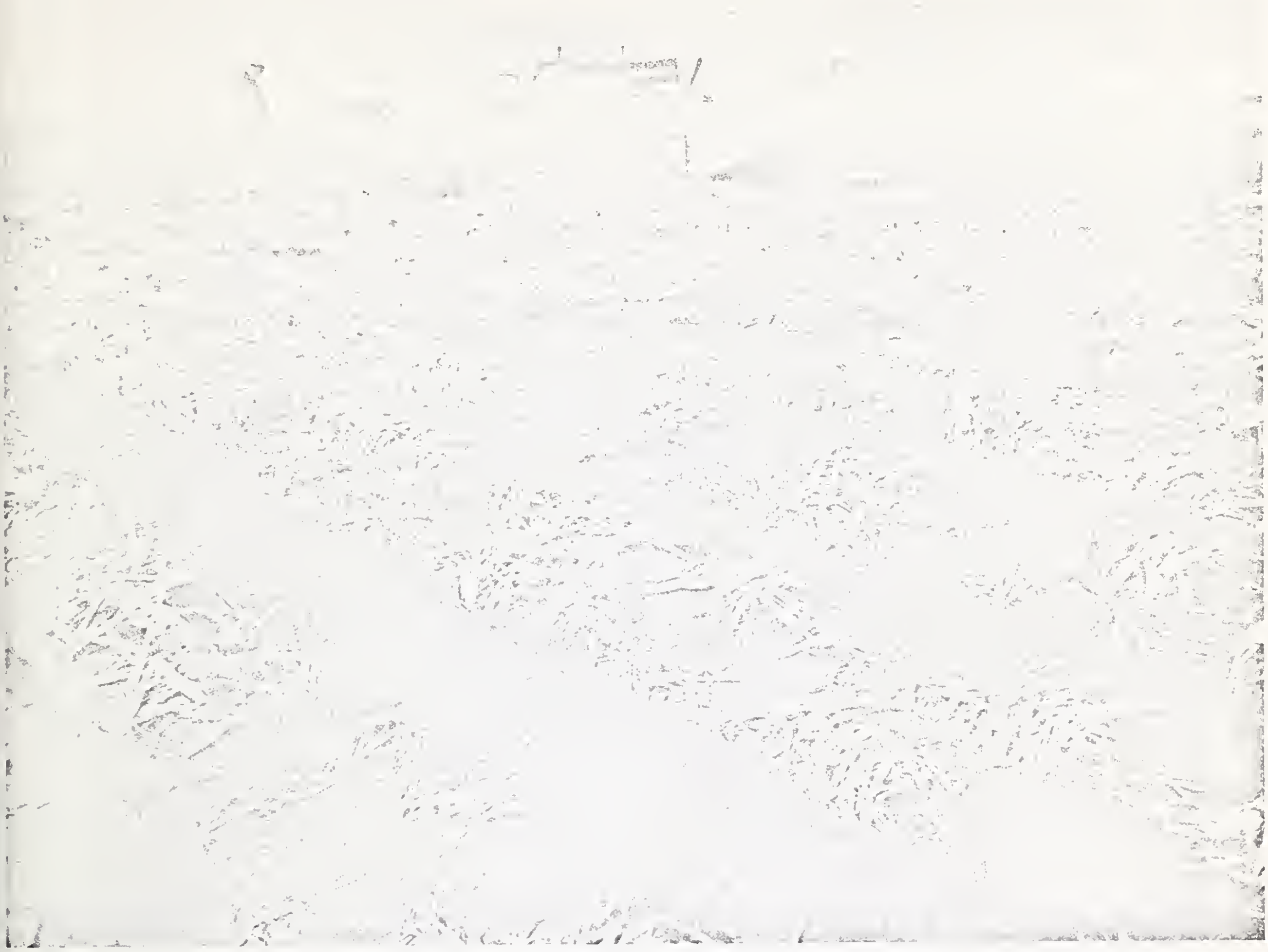
Texas Tech Farm (SE 1/4 Sec. 21, Blk. A), Lubbock County, Tex.

Soil Unit: 7X-A-1R   Capability Unit: II-7X   Soil Type: Portales fine sandy loam

November 6, 1952. Machine-stripped storm-proof cotton. Preplanting irrigation. Yield of approximately 1/2 bale per acre. Planted in 40-inch rows, with average spacing of 3.1 inches between plants in row. Stalks 12 to 14 inches high. Field has been under cultivation since 1947. Soil in middles pulverized by harvesting machinery. Soil in ridges slightly crusted and fairly stable. The field is moderately susceptible to wind erosion.

Surface Conditions:

Mechanical composition	73.1 percent sand,	11.3 percent silt,	15.6 percent clay
Residue *R*			430 lbs./acre
Ridge roughness equivalent *K*			4.2 inches
Velocity reduction at 1-inch height due to cover			25.0 percent
Force taken by cover above 1-inch height			44.0 percent
Soil fraction less than 0.84 mm.			73.3 percent
Soil eroded in tunnel			0.72 ton/acre



SITE 19

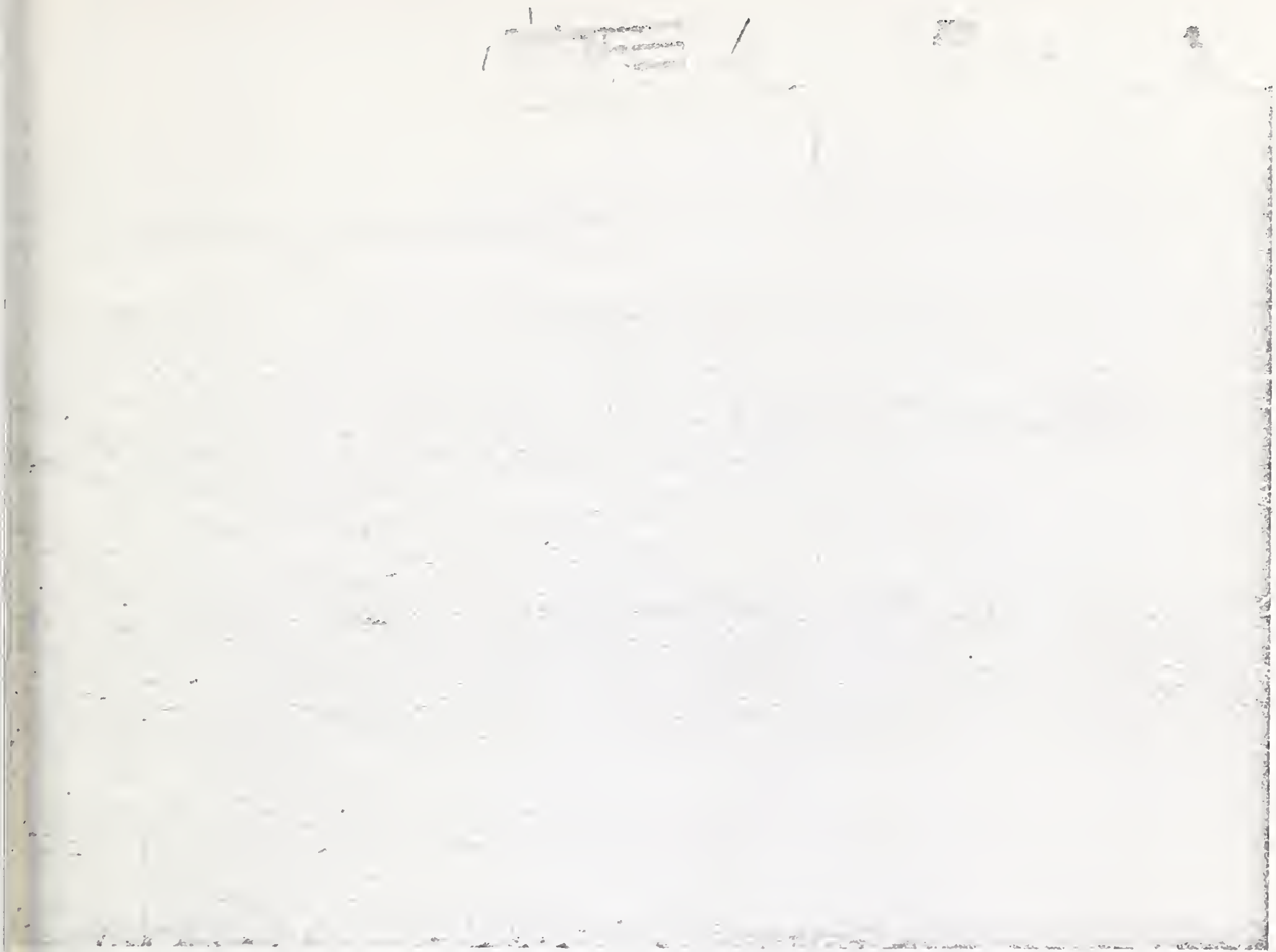
Terry County Experiment Station (S 1/2 Sec. 94, Blk. D11), Tex.

Soil Unit: L12-A-2R Capability Unit: IV-L12 Soil Type: Amarillo loamy fine sand

January 27, 1954. Short leafy sorghum sown for cover in rows 1 foot apart. Leafy condition makes very effective surface protection despite the soil being highly erodible. This serves as a fine example of what can be done to protect highly erodible land from blowing even in dry years. The field has caught some loose sand from neighboring areas. It was plowed 18 inches deep in 1952 to bury loose sand. Erodibility of this field is moderate.

Surface Conditions:

Mechanical composition	86.8 percent sand,	7.3 percent silt,	5.9 percent clay
Residue *R*			553 lbs./acre
Ridge roughness equivalent *K*			3.1 inches
Velocity reduction at 1-inch height due to cover			27.8 percent
Force taken by cover above 1-inch height			48.0 percent
Soil fraction less than 0.84 mm.			86.5 percent
Soil eroded in tunnel			2.50 tons/acre



SITE 20

Terry County Experiment Station (S 1/2 Sec. 94, Blk. D11), Tex.

Soil Unit: L12-A-2R Capability Unit: IV-L12 Soil Type: Amarillo loamy fine sand

January 28, 1954. Cotton planted in unleveled furrows 36 inches apart; failed in 1953. Sorghum was seeded in 1-foot rows, grew to 6-inch height and is giving only partial protection. Soil surface is fairly crusted but has a slight amount of loose sand particles on top. This field eroded moderately during the January 1954 high winds. Erodibility of this field is rated moderately high.

Surface Conditions:

Mechanical composition	90.9 percent sand,	5.5 percent silt,	3.6 percent clay
Residue *R*			131 lbs./acre
Ridge roughness equivalent *K*			5.2 inches
Velocity reduction at 1-inch height due to cover			17.6 percent
Force taken by cover above 1-inch height			32.5 percent
Soil fraction less than 0.84 mm.			84.4 percent
Soil eroded in tunnel			3.00 tons/acre

SITE 21

Texas Tech Farm (SE 1/4 Sec. 21, Blk. A), Lubbock County, Tex.

Soil Unit: 7X-A-1R   Capability Unit: II-7X   Soil Type: Portales fine sandy loam

November 6, 1952. Machine-stripped storm-proof cotton. (Same as site 18.) Surface has been shallow-chiseled prior to tests to break up surface crust, level ridges and partly cover leaf and boll trash. This or similar operations tend to increase the erodibility of a field. This field now is highly susceptible to wind erosion.

Surface Conditions:

Mechanical composition	69.6 percent sand,	16.4 percent silt,	14.0 percent clay
Residue *R*			375 lbs./acre
Ridge roughness equivalent *K*			2.7 inches
Velocity reduction at 1-inch height due to cover			6.0 percent
Force taken by cover above 1-inch height			12.0 percent
Soil fraction less than 0.84 mm.			70.8 percent
Soil eroded in tunnel			5.33 tons/acre

SITE 22

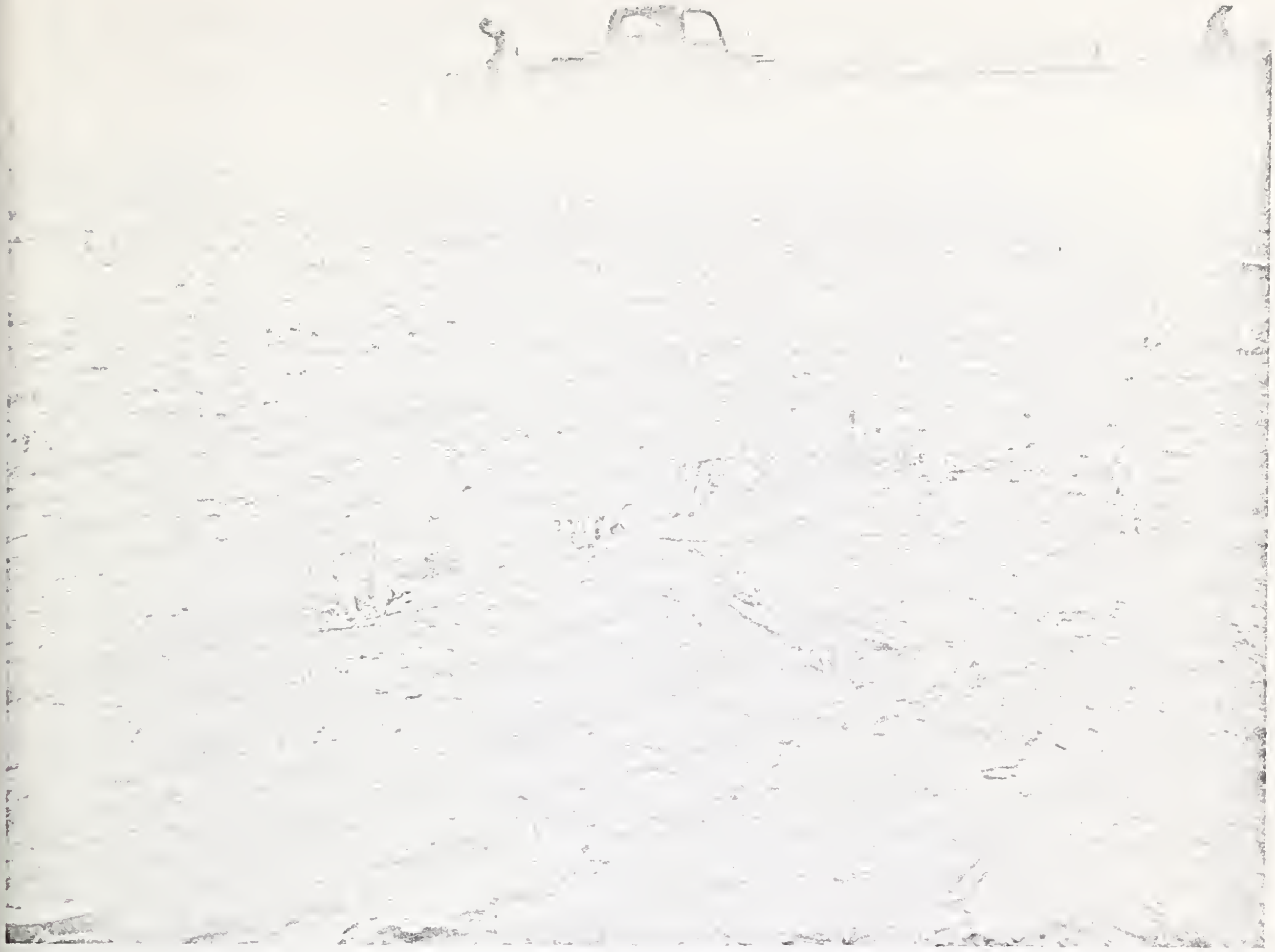
Terry County Experiment Station (S 1/2 Sec. 94, Blk. D11), Tex.

Soil Unit: L12-A-2R Capability Unit: IV-L12 Soil Type: Amarillo loamy fine sand

January 27, 1954. Sorghum failed, giving little protection to the soil. At least 50 percent of topsoil is blown out at present. Heavier subsoil is now being brought to the surface by normal tillage. Whatever crust was present has been destroyed by abrasion from soil movement. Much soil was blown out by high winds during January 1954. Some loose erodible sand particles still remain. The soil surface is virtually unprotected. Erodibility rating of this field is high.

Surface Conditions:

Mechanical composition	86.8 percent sand,	7.1 percent silt,	6.1 percent clay
Residue R			485 lbs./acre
Ridge roughness equivalent K			4.3 inches
Velocity reduction at 1-inch height due to cover			20.6 percent
Force taken by cover above 1-inch height			37.0 percent
Soil fraction less than 0.84 mm.			88.4 percent
Soil eroded in tunnel			5.74 tons/acre



SITE 23

Terry County Experiment Station (S 1/2 Sec. 94, Blk. D11), Tex.

Soil Unit: 70-A-2R Capability Unit: III-70 Soil Type: Amarillo fine sandy loam

January 28, 1954. Sorghum failed completely. Sown in fall to wheat, which germinated but grew little and offers little protection to the soil. The soil is fairly well aggregated but has some loose material on the surface capable of being moved by moderately high wind. Erodibility of this field is high.

Surface Conditions:

Mechanical composition	88.2 percent sand,	5.0 percent silt,	6.8 percent clay
Residue *R*			1,258 lbs./acre
Ridge roughness equivalent *K*			2.5 inches
Velocity reduction at 1-inch height due to cover			15.7 percent
Force taken by cover above 1-inch height			29.1 percent
Soil fraction less than 0.84 mm.			82.8 percent
Soil eroded in tunnel			14.0 tons/acre

SITE 24

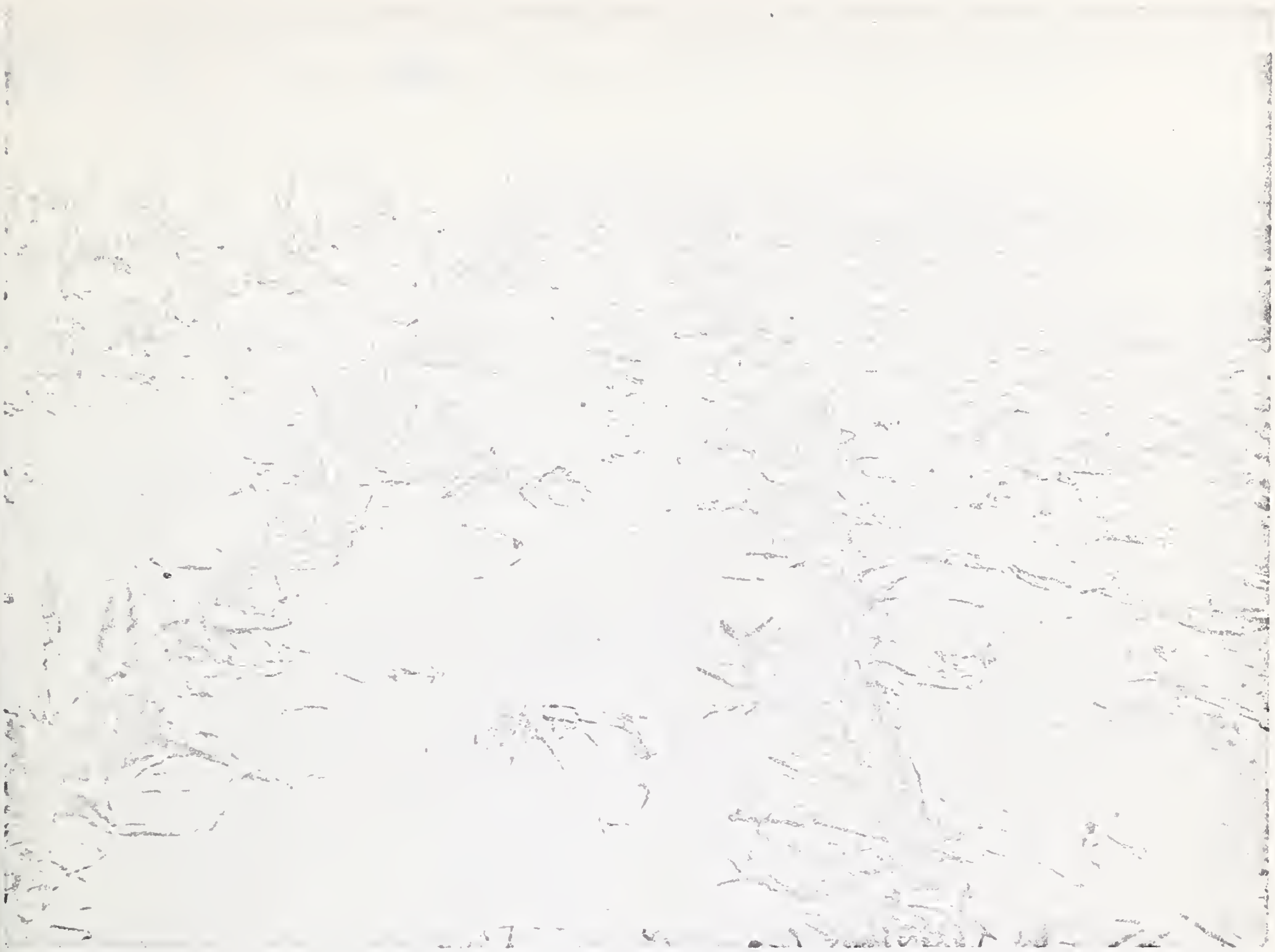
Farrar Farm (NE 1/4 Sec. 146, Blk. T), Terry County, Tex.

Soil Unit: $7X_f$-A-2R   Capability Unit: III-$7X_f$ Soil Type: Drake fine sandy loam

January 26, 1954. Machine-stripped irrigated cotton giving little protection to the soil. The soil is highly erodible. Much of the erodible material has been blown away by January 1954 winds, exposing some nonerodible lime concretions on the surface and partly stabilizing it. Despite this partial stabilization, erodibility of this field is still exceedingly high.

Surface Conditions:

Mechanical composition	77.7 percent sand,	18.3 percent silt,	4.0 percent clay
Residue *R*			401 lbs./acre
Ridge roughness equivalent *K*			1.6 inches
Velocity reduction at 1-inch height due to cover			17.0 percent
Force taken by cover above 1-inch height			31.1 percent
Soil fraction less than 0.84 mm.			83.5 percent
Soil eroded in tunnel			27.3 tons/acre



SITE 25

Farrar Farm (NW 1/4 Sec. 146, Blk. T), Terry County, Tex.

Soil Unit: $7X_f$-A-2R   Capability Unit: III-$7X_f$ Soil Type: Drake fine sandy loam

January 26, 1954. Sorghum failed and unharvested. Cover is poor but a little better than that of site 24 on similar soil. Because of better cover, more erodible material is trapped on the surface than on site 24. The average depth of fine, drifted material is about 1 inch. Erodibility of this field is exceedingly high.

Surface Conditions:

Mechanical composition	90.3 percent sand,	7.1 percent silt,	2.6 percent clay
Residue *R*			238 lbs./acre
Ridge roughness equivalent *K*			3.9 inches
Velocity reduction at 1-inch height due to cover			11.8 percent
Force taken by cover above 1-inch height			22.4 percent
Soil fraction less than 0.84 mm.			96.3 percent
Soil eroded in tunnel			32.5 tons/acre

SITE 26

Pate Farm (SE 1/4 Sec. 150, Blk. T), Terry County, Tex.

Soil Unit: L12-A-2R   Capability Unit: IV-L12   Soil Type: Amarillo loamy fine sand

January 26, 1954. Very thin sorghum stubble on a field that produced virtually no yield in 1953. The soil is extremely erodible but the stubble, though sparse, offers considerable protection against wind. About 3 inches of loose erodible sand is present on the surface. Considerable wind erosion occurred on this field in January 1954. Erodibility of this field is, at present, exceedingly high.

Surface Conditions:

Mechanical composition	94.6 percent sand,	4.6 percent silt,	0.8 percent clay
Residue *R*			571 lbs./acre
Ridge roughness equivalent *K*			4.2 inches
Velocity reduction at 1-inch height due to cover			10.6 percent
Force taken by cover above 1-inch height			20.1 percent
Soil fraction less than 0.84 mm.			99.6 percent
Soil eroded in tunnel			62.5 tons/acre

SITE 27

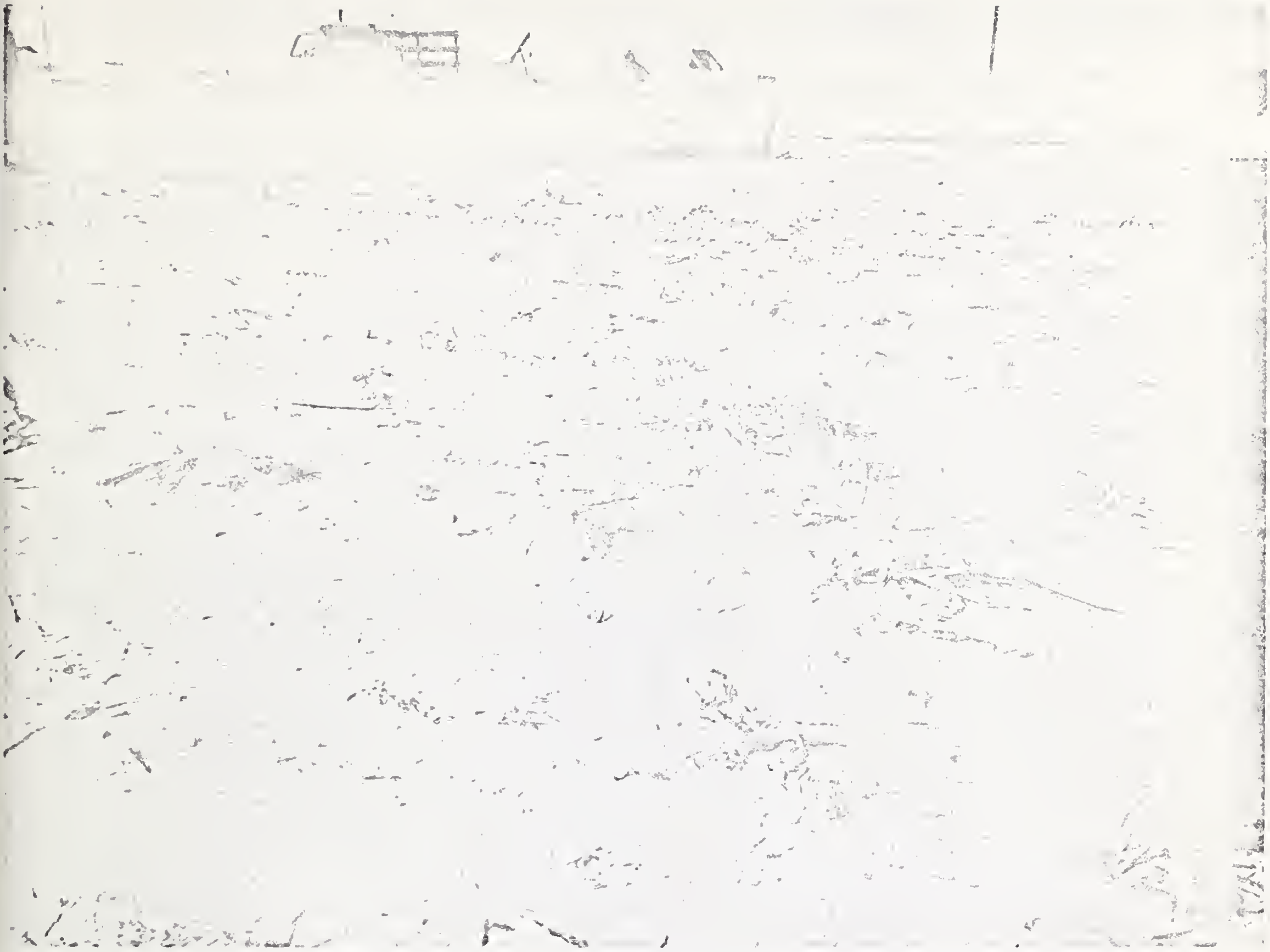
Terry County Experiment Station (S 1/2 Sec. 94, Blk. D11), Tex.

Soil Unit: 70-A-1L Capability Unit: III-70 Soil Type: Amarillo fine sandy loam

January 28, 1954. Sorghum failed and unharvested. Drift accumulation of dune sand 2 to 3 inches deep. Blowouts occur whenever cover is absent or very light. Soil is exceedingly erodible and the average amount of vegetative cover is meager. Erodibility rating is exceedingly high.
NOTE: A wind-tunnel test was carried out during the forenoon when a heavy fog left the soil surface quite wet. The amount blown would have been greater, it is believed, if the surface had been dry as in all other fields.

Surface Conditions:

Mechanical composition	93.6 percent sand,	3.3 percent silt,	3.1 percent clay
Residue R			604 lbs./acre
Ridge roughness equivalent K			3.3 inches
Velocity reduction at 1-inch height due to cover			12.2 percent
Force taken by cover above 1-inch height			22.9 percent
Soil fraction less than 0.84 mm.			99.8 percent
Soil eroded in tunnel			66.3 tons/acre



SITE 28

Kelly Farm (N 1/2 Sec. 2, Blk. D12), Terry County, Tex.

Soil Unit: L12-B-2L   Capability Unit: IV-L12   Soil Type: Amarillo loamy fine sand

January 27, 1954. Sorghum failed completely. There is very little residue on the surface and the surface soil is exceedingly erodible. There is about 3 inches of loose accumulation on the surface. Erodibility rating is exceedingly high.

Surface Conditions:

Mechanical composition	93.0 percent sand,	5.1 percent silt,	1.9 percent clay
Residue *R*			532 lbs./acre
Ridge roughness equivalent *K*			1.9 inches
Velocity reduction at 1-inch height due to cover			3.0 percent
Force taken by cover above 1-inch height			6.0 percent
Soil fraction less than 0.84 mm.			99.1 percent
Soil eroded in tunnel			152.5 tons/acre

SITE 29

Terry County Experiment Station (S 1/2 Sec. 94, Blk. D11), Tex.

Soil Unit: 70-A-1L Capability Unit: III-70 Soil Type: Amarillo fine sandy loam

January 28, 1954. Land seeded to wheat in fall of 1953 has been blown badly. The soil is highly erodible, the surface is smooth, and the cover poor. About 1.5 inches of drift is accumulated on the surface. Erodibility rating is exceedingly high.

Surface Conditions:

Mechanical composition	88.3 percent sand,	6.5 percent silt,	5.2 percent clay
Residue *R*			271 lbs./acre
Ridge roughness equivalent *K*			1.4 inches
Velocity reduction at 1-inch height due to cover			18.8 percent
Force taken by cover above 1-inch height			34.3 percent
Soil fraction less than 0.84 mm.			94.9 percent
Soil eroded in tunnel			192.5 tons/acre